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EDITORIAL NOTES.

"Undue Preference" in Electric Lighting.

THE matter of "undue preference" in electricity supply charges has again been before the Courts; and this time in connection with a case referring entirely to lighting. There was no question, however, that the point in dispute was governed by the Long Eaton case, in which a preference in charge was given to any power consumer who also used electricity for lighting. The particular form of "undue "preference" which the South Metropolitan Gas Company brought before Mr. Justice Eve on Friday, the defendants being the South London Electric Supply Corporation, has been rather a favourite plan, in the case of some electricity supply undertakings, to induce people becoming electricity consumers to altogether abolish gas from their premises for illumination. Irrespective of quantity or hours of use, or number of rooms in a house, or any other factor which may cause a difference in circumstances—these being matters over which the electricity suppliers have no control, temporary or continuous—these undertakings have differentiated in the price per unit charged to whole-house users of electricity for lighting and partial users for that purpose. In this instance, the difference was ½d. per unit; and it is one of the two instances of "undue preference" referred to in the opening paragraph of last week's "Electricity Supply "Memoranda." Almost immediately after the issue by the Electric Supply Corporation of the circular offering the preference to whole-house lighting consumers, the South Metropolitan Gas Company commenced proceedings with the view to testing the legality of the offer. But Mr. Justice Sargant's Long Eaton judgment no doubt caused the Electric Supply Corporation to waver in regard to the position that they were proposing to defend, and the result in the Court of Appeal gave the final stroke which brought them promptly to their senses. Certain admissions were made in their statement of defence, which enabled the Gas Company to (and to this the Electric Supply Corporation assented) ask the Court for a declaration in their favour. The only point in dispute was as to whether the Gas Company should also be granted an injunction. As amended [see report in "Legal Intelligence" on a later page], Mr. Justice Eve thought that the declaration was sufficient, though he agreed the Gas Company should have "liberty "to apply," if necessary. Defendants were also ordered to pay the costs of the action.

These, briefly put, are the facts. It is, however, a noticeable condition that Counsel when arguing on the side of these "undue preference" delinquents appear to suffer from temporary aberration in respect of their logic. When this matter was under discussion before Mr. Justice Eve, Mr. Tyldesley Jones was trying to show that there were some cases where price differentiation might be allowed. His example was this: "Suppose a man lights his living-"room with electricity and his bedroom with gas, and you "say to him 'if you make a change and light your bedroom "by electricity, I can give you a better rate.'" But why should you? Counsel explains: Because "the demand for "light to the bedroom would come on at a different time "from the light for the living-room." The advocates of "undue preference" rarely open their mouths without showing the real absurdity of their position. It would be interesting to hear Mr. Tyldesley Jones on how he is going to ensure a due observance of the conditions necessary to guarantee that there is no "undue preference." Supposing the man who lights his living-room by electricity and his bedroom by gas chooses to use the former until midnight before retiring, while the man who employs electricity in both living-room and bedroom is comfortably between the sheets by 10.30, it is the former, and not the latter, who should have the preference. Supposing, again, the former individual uses four 32-candle power lights in his living-room (of which he is a long-hour user), and the other man who has the preference only uses two 32-candle power lights, wherein comes the justice? If Mr. Tyldesley Jones cannot discover better examples of where differential prices may be given, he will find himself in a troublesome tangle—just as the electricity suppliers find themselves through inability to understand the statutory conditions laid down for their guidance. The ludicrous and baseless arguments with which they have apparently been persuading themselves that their preferential tactics have been clever and lawful might anyway be dispensed with by members of the Bar. It is true that many men engaged in commercial pursuits do not know much about the law; but gentlemen learned in the law might be expected to know sufficient about commercial and everyday matters to be aware that the profitableness of the two hypothetical consumers such as Mr. Tyldesley Jones referred to might vary from night to night, but the one against whom preference was given might be, on the whole, far more profitable than the favoured one.

The Ilford case has, on the application of the District Council, been set back until next term, although the Gas Company were quite prepared to proceed, but raised no objection to postponement. It is considered that one branch of the case is covered by the Long Eaton judgment; and the other branch by other decisions. In view of this, it is just possible that there may be a settlement; but, if not, Mr. Justice Sargant, who is going to hear the case, will take it on the 12th prox.

Evans on Purification by Heat.

WHENEVER the progress of gas purification methods is treated upon, the system will be mentioned that so far has proved the most practicable and successful for the reduction of the sulphur compounds in coal gas to the as yet attained lowest point, and the name of Evans will always be associated with it. Upon Mr. E. V. Evans, the Chief Chemist of the South Metropolitan Gas Company, has fallen more labour in searching out (where other men had failed) the lines to a successful issue for the process of removing carbon bisulphide by heat, and to his lot has fallen more vexation through the work of the laboratory in this regard failing to be always corroborated on the working scale, than upon and to any other man, though he has always had willing collaborators on the staff of the Company, and a stanch supporter, with an inexhaustible fund of encouragement, in the Chairman (Mr. Charles Carpenter, D.Sc.). As has been shown by the contributions of Mr. Carpenter, a sound mechanical and chemical success has been achieved through the constant work of years, and what is more this success is accompanied by a high efficiency and working economy, as proved by individual plants—the largest of 15 million feet capacity at the Company's East Greenwich works. But though this system of purification is essentially a physical and chemical one, until yesterday week, it had never been brought directly to the notice and under the survey of experienced chemists in meeting assembled. Then, however, Mr. Evans, who has hitherto kept himself very much in the background in connection with the process (although his Chairman has been unstinting in his awards of praise), read a paper on its physical and chemical aspects before the Society of Chemical Industry. But there was not any considerable discussion on the subject—limited practical experience telling against it. In fact, the author of the paper is naturally *facile princeps* among chemists in this matter, seeing he is the only one (other than his assistants) who has had both laboratory and working experience of the process, and has lived all the way through with the interest and the difficulties of development to the stage of notable success.

In his public utterances on the subject before gas engineers, Mr. Carpenter had previously gone so thoroughly into the whole question of the process that he left Mr. Evans little to say that is fresh to our readers. But there was in his paper terse presentation of the physical and chemical side of the actual investigation—from the adopted fundamental considerations and principles, particularly in relation

to the considerable quantities of gas such as have to be dealt with in works as large as those of the South Metropolitan Company. The alternatives to heat purification were examined carefully, and dismissed as technically or economically impracticable. The paper takes us again over the step-by-step investigation that proved possibilities, and guided to realization. The story of the search for the most suitable contact substance or catalyst was re-told—the investigation resulting in the most active catalytic agent being found to be a highly porous fireclay, impregnated with reduced nickel. The importance of, and in fact necessity for, preheating the gas in making the process a success was also referred to. Later the question of the efficiency was dealt with; and from this point emerged two or three discussable points. One of the controlling factors in efficiency is the accumulating deposit on the catalyst; and associated in interest is the matter of its revivification. Those interested in the system would be glad enough to find out some means of prolonging the activity of the contact agents before aëration is required; for it is obvious that the longer their period of activity, the lower would be the cost—low as it already is for the service rendered. The catalyst, Mr. Evans says, maintains its activity for 30 to 35 days, after which period the efficiency of the reaction gradually decreases. It is not stated in the paper whether it is immediately the efficiency begins to fall off, or some time afterwards, that the process of revivification is taken in hand. But the statement is made that a week is required for revivifying the contact material of any one unit of the plant. Now if a unit is shut-off for revivification purposes at the period when the activity of the material begins to fail, and a week is occupied in revivification, this means that each unit must be under revivification about eight-and-a-half weeks in a year. At East Greenwich there are five three million cubic feet units; and, assuming that there is no important flaw in this calculation through the absence of more express data, then the revivification of the five units means a considerable number of weeks out of the year. However, not upon detail of this kind, but upon the efficiency for the purpose in view, and the economy with which this efficiency is obtained, judgment must rest. And a reduction of the sulphur compounds to between 7 and 8 grains per 100 cubic feet shows an unprecedented efficiency for a practicable system, and the cost of 0·299d. per 1000 cubic feet, including interest, depreciation, &c. (as given for the large-scale plants in Mr. Carpenter's Institution lecture), is an economical one.

Of course, there is no use in becoming an extremist in this matter of gas purification from sulphur. Refinement beyond that achieved by the South Metropolitan Company may be a very costly process, and therefore neither feasible nor economical. The system over which Mr. Evans and his collaborators have spent so many anxious days (we might say, years) produces a reduction of the sulphur compounds by something like 80 per cent.—that is, to (as just mentioned) about 7 or 8 grains, which is good enough for any purpose. The question has been raised as to the possibility of getting below this. Dr. Colman started it during the discussion on the paper by trying to ascertain the nature of the remnant sulphur. But Dr. Colman has too close an association with practice to seek for an excessive chemical refinement which would override practicability and working economy. His interest in the matter was chiefly the academic one of learning the form in which the residual sulphur existed. He suggested that probably the greater part of it was thiophene; and Mr. Evans confirmed that this was so to the extent of about 60 per cent. This prompted the question as to the prospects of getting below the 7 or 8 grains. It could be done by washing; but, in Dr. Colman's view, there is an objection. Thiophene and benzene have a chemical likeness; and to wash-out the thiophene would also have an effect on the benzene, which would detrimentally affect the illuminating power and calorific value of the gas. But apparently Mr. W. J. A. Butterfield is not at present prepared to give up hopes of a washing process producing a complete clearance, although he does not supply any indication as to how far in this respect his faith goes. It is one of those matters that can only be finally determined by experiment; for theoretical speculation will not help us much, and, in connection with gas-purification problems, theoretical speculation has often had a bad spill when practically tested.

However, the process referred to by Mr. Butterfield is one for the removal of carbon bisulphide by washing with alkali; and this, it may be supposed, would also remove the thiophene. If this be so, the residual sulphur would then remain at only about 2 to 3 grains (providing only the thiophene of the remnant were removed); and this in all conscience is coming down to a degree of refinement that is unnecessary. The process to which Mr. Butterfield referred, he states, has been tried in Sweden; and it was to have been experimented with in this country a short time since. The manner in which the statement was made suggests that the process has not yet been under trial here. When, if ever, it is tried (or perhaps additional information can be obtained from Sweden), many others besides Mr. Butterfield will be highly interested in learning whether the sulphur can be reduced by it to "practically *nil*," and without any detriment to the essential qualities of the treated gas. But there must be some relation between result and cost; and at the low cost at which the heat purification system works per 1000 cubic feet in getting down to the 7 or 8 grain level in sulphur purity, a very strong case of justification would have to be shown if, to go below this level, the working cost of purification was increased beyond that of the heat purification plant. A standard quality of gas is a very strong point with the South Metropolitan Company; and, as Mr. Evans says, there is no doubt whatever that the Company would be one of the first to adopt any other process if it could be carried out commercially, and, we might add, without complication. The whole point is as to the cost of removing the additional grains, and whether the result would be worth the expense. We should doubt it; but the proof one way or the other has yet to be obtained.

Yet another point of interest raised was as to whether the deposit on the catalyst was due entirely to the decomposition of the carbon bisulphide. In Mr. Carpenter's Institution lecture, there was suggestion that it was. He said: "Laboratory experiment has shown that, when pure "materials are used, the carbon deposited is in theoretical "proportion to the carbon bisulphide decomposed." But in practice it is not so. Mr. Evans now states that, after each aëration, "it was known how much carbon was burnt "off in the plant. It was 700 lbs. in the week. If one "calculated-back to the amount of work done, it would be "found that this was about double the amount of carbon "represented by the carbon bisulphide decomposed; so that "certain unsaturated hydrocarbons of the gas must have "supplemented it." It will be noted in this connection that the illuminating power and calorific value figures show that the gas qualitatively remains uninjured by the treatment.

During the discussion, a suggestion was made by Mr. F. Napier Sutton, one of the Divisional Inspectors under the Alkali Works Regulation Act, to which there must be brief allusion. He seems to encourage the belief that this successful reduction of the sulphur compounds by the South Metropolitan Gas Company will result in the heat process of purification being forced on other gas undertakings. We do not think it will. Mr. Carpenter himself does not consider it desirable. In his Institution lecture, he remarked: "I am strongly of opinion that irritating restrictions as to "sulphur impurity are unnecessary. Gas undertakings must "take it out in their own interests if for no other reason." This is the common sense of the matter. Unless there is now substantial evidence supplementing that advanced before Lord Rayleigh's Committee, and showing the conclusions of the Committee to be wrong, there is not likely to be a reversal of the parliamentary decision affecting sulphur compounds. As we have previously remarked, and as Mr. Butterfield pointed out at the meeting yesterday week, this heat purification process was evolved by the South Metropolitan Company's staff subsequent to the securing by the Company of relief from the restrictions relating to sulphur compounds other than sulphuretted hydrogen. All the labour, all the expense, all the perseverance, now rewarded, have been due to one thing only—a sense of duty; the duty of giving to consumers the best possible commodity, and so protecting in the most potent way the capital invested in the Company. The work is entirely attributable to the Company's own initiative; and there is confidence on our part, as on the part of other close observers of the influences that have crowded upon the industry, that time will see, without the whip of statutory prescript, the sulphur compounds in distributed gas a dwindling quantity. Self-interest has a commanding way with it, when attacked through a preventable cause; and the work, and the results of the work, as described by Mr. Evans, show that in gas the sulphur content as a "cause" is a preventable one. The only thing that troubles one now is as to the prospects of obtaining some

other equally efficient process which will cost less money for installation and do the work as economically and efficiently as the heat system developed by Mr. Evans and his colleagues, by the help of Mr. Carpenter and his fellow Directors. Looking round, a competitive commercial process does not yet present itself; and so far the examination of possible alternatives does not give any great encouragement to hope.

The Tar Payment Difficulty Revived.

Only on the 24th ult., we were congratulating the gas industry on the fact that the differences that had, in consequence of the circumstances occasioned by the war, arisen between tar producers and distillers had been adjusted by the Joint Committee (brought together through the mediation of the Council of the Institution of Gas Engineers) representing the two parties, and that a working arrangement had been evolved from their deliberations. The causes for congratulation have been short-lived; for the issue of the Committee's conferences, resolutions, and good intentions appears to have been rejected in certain quarters, and the arrangement rendered mutually unworkable. The Secretary of the Institution (Mr. Walter T. Dunn) has now informed us that a circular has been issued to all gas undertakings in the country announcing the failure of the efforts of the Committee to fix the minimum price of pitch, and that therefore the proposed conditions for deliveries of, and payments for, tar during the war crisis are withdrawn. Upon this the Joint Committee recommend tar producers to make their own arrangements in regard to their tar contracts. The recommendation reminds of "Hobson's choice." The only course left open to the producers is the one recommended. For this prompt restoration of the *status quo ante*, no reasons are assigned in the circular.

Home Synthetic Dye and Colour Industry.

It is a satisfaction to the gas industry to observe that those who are most intimately acquainted with all the intricacies of the synthetic dye and colour industry are among the most enthusiastic over the Government's proposal for the formation of a large national company to satisfy the wants of this country in this particular, and so to detach itself from any reliance henceforth on Germany. There is but little sympathy on our part with those who would throw cold water upon the scheme with a simple *non possumus*, as though the ability of this country, while equal to the task of blockading the trade and commerce of Germany, was altogether deficient in power—not to establish a new industry here, but to successfully build about the nucleus of the industry which is already in our midst. We do not despise the immensity of the difficulties, nor the imposing character of the work to be done. While, however, this country requires synthetic dyes and colours to the value of (say) two million sterling a year, and although it at present only meets requirements to the extent of—some say a quarter of a million, others half a million, this shows the possession of a pretty good foundation for building-up the requisite means for the dye-providing of the textile and other industries of the country.

The Government plan for dispensing with Germany's aid was under consideration the other day at a meeting, held at the Manchester Town Hall, of those interested in the textile and dye-producing industries; and on that occasion Lord Moulton, who has been presiding over a small Committee appointed by the Government to consider the position of this country in face of the cutting-off of supplies from Germany (we hope that the nitrate of thorium question has been brought before the Committee), touched the key to the whole situation as it affects the establishment of a concern large enough to meet the aniline dye requirements of this country. He said that the Government were going to assist; but the company in view must be one with a large capital, under national control, and of undoubted loyalty, and must spring from the co-operation of all concerned. This is the point. There must be some cohesion between the manufacturing company and the users of synthetic dyes and colours; and to henceforth ensure this cohesion and loyalty, and profitable utilization of the capital invested in the company, the bulk of the capital should be found by, and the management should be divided between, the users as well as the producers of the dyes and colours. Capital investment will guarantee patronage when Germany returns, with tempting baits, to get back its old British customers who have so largely assisted to make flourish the aniline dye industry of the arch-enemy country. In this way, at this particular time capital provision for the new company is of paramount importance as an assurance for the future.

Specially trained men will, of course, be required for the vast work of the venture—if successfully floated. We have trained men in this country to-day, but not nearly sufficient of them. Patriotism, however, will early assist in producing the necessary skill, just as it has raised Lord Kitchener's army in solid mass from scattered, untrained units as they existed before. An army cannot be built up and made efficient in a day, nor can an army of workers for an industry that needs to meet the demand of an eight-fold extension. Supplies from Germany are not at all among immediate possibilities; and there is every reason why the present time should be spent in constructive work to show Germany that in this respect at any rate she is dispensable. It is not, however, only in the matter of capital that the Government will have to show its sympathy in the future, if its desire is sincere to enrich our country through industry. The German Government long since recognized that science is at the base of industry, and that the mobility of native industries, and their capacity for transferring their products to other countries, depend in no small degree on the facilities that the Government could legitimately give them—for example, in duty-free alcohol for the chemical industries, for which necessary our own manufacturers pay very heavily. But the British Government are awakening to the necessity for a competitive equipoise, if not superior advantage, for the industries of this country; and if the awakening is followed by a maturing of action, we shall have something for which to thank Germany while that country is wallowing in the mire produced by its own inflated desire, arrogance, and recreant acts.

Importance of Detail in Hot-Water Installations.

Water heating by gas for domestic and trade purposes is making rapid headway, where gas methods are exploited in a proper manner, through mainly the example of efficiency. The enthusiasm displayed by the makers of water-heating gas appliances in developing new designs is the best possible index to the business that is being done, or is opening out in this line. But with it all, there is a lamentable lack in certain quarters of a knowledge of even the rudiments of efficient installation; and hence, in those districts, there has been complaint, and, we fear, a set-back given to the water-heating branch of business. Some of the makers, too, of gas circulating-boilers are not altogether innocent of blame in this regard, for advertised simplicity of installation does not apply to all cases. Conditions vary in almost every instance, unless work is being done in a row of houses, which are as much alike as peas in a pod. Not by any means a few times in the brief history of the gas circulating-boiler business, hot-water experts have had to be called in, and work has had to be unpicked, and done again, to the annoyance of householders, through original incompetence in setting about the work. However, the recognition of the necessity for individual treatment in the matter of the details of installation, and of a better knowledge of elementary details, ought to come about from the repeated warnings and advice given at various technical meetings.

Last week-end two Junior Associations had before them the question of the right principles to be followed in arranging for hot-water supplies by means of gas heating. If papers of this kind do not open the eyes of some of our gas managers to the necessity for a proper training for the men who deal with this work, then it is difficult to know how to cause the recognition; and possibly the best thing their friends can wish them is that the serious dissatisfaction of some important consumer may befall to arouse them to the fact that this is not work to which to put an ordinarily trained gas-fitter without special instruction and close supervision. There is something more in it than the mere ability (besides doing gas-fitting work) to wipe a joint. Everything in a hot-water circulating system, especially when being connected-up to an existing coal-heated one, wants to be studied from the location of boiler and tanks to the pipes and connections, in order that the utmost duty may be obtained. But what happens in some cases? A gas-fitter visits a house; and his main object appears to be to find out where he can most conveniently to himself connect-up the gas-boiler. When this is done, it is frequently quite a piece of luck if the boiler and system in combination efficiently perform their duty. The fact that in many other districts

this hot-water business goes along successfully is proof that it is all a matter of training, or at all events the result of confiding the work to a responsible and qualified superintendent. From such practical papers as the one that Mr. T. F. C. Potterton contributed to the meeting of the Southern Juniors on Friday evening, and the one submitted by Mr. W. B. Cobb, of Birmingham, at the meeting of the Midland Juniors on Saturday, many useful hints on the general subject can be picked up; and in them the truth is emphasized of what we have already said—that the making of hot-water installation is a matter for study, so as to get the highest efficiency, and not for any haphazard or even uniform mode of procedure. The publication of Mr. Potterton's paper is unavoidably deferred to our next issue.

In his contribution, Mr. Cobb treats of some of the elementary details connected with the work of water-heating installations, as well as giving typical instances of low-pressure steam systems for heating, working in conjunction with domestic hot-water supply or separately. By the way, he believes that this system of general heating, in conjunction with room warming by gas-fires, is going to have large vogue in this country. We hope he is right—at any rate, there are certainly signs of increasing favour. The main part of the paper, however, deals with the provision of hot water by the gas circulating-boiler. The remarks in this regard are worth reading by those who know less than Mr. Cobb about the subject, and by those who have not yet learned the road to the giving of the highest efficiency in hot-water supply, on the most economical terms, by means of gas-heated boilers. Where there is not efficiency, the hot-water supply business by gas is bound to die a natural death. There is one thing against which gas suppliers should guard themselves. Some of their men do not use sufficient discrimination, and like to get in circulators wherever possible. The convenience in all cases is undeniable; the desirability, when a properly fitted gas-geyser would do all the work required by a small household, and do it economically, is open to question. This is a comparatively new business; and if it is to make good pace, it will not brook slovenly treatment.

Flash-Points Exceeding 150° Fahr. Exempt.

What purported to be a complete reprint of the new Order of Council that was in the hands of the writer of the paragraph published last week omitted an important clause, and this led to the remark that there could be no question now as to the inclusion of all gas-works oil-tanks in the regulation requiring the construction of retaining-walls or embankments to prevent the escape of the liquid in the event of any mishap to the tank. That is not altogether correct; and now there does not seem much room for any confusion regarding the question. The new Order in Council distinctly indicates that the regulation as to embankments and retaining-walls refers to stored petroleum, exceeding 100 gallons in quantity, and having a flash-point below 150° Fahr. (Abel). The new regulation is an amendment of the previous regulations which undoubtedly did refer to all petroleum oils of whatever flash-point. This was confirmed by the Home Secretary's reply to Dr. Lessing's inquiry [see *ante*, pp. 284, 374]. Probably the Home Office have found out the physical impossibility of enforcing the regulation in many cases, and so have substituted the new one fixing the limit of the flash-point at 150° Fahr. The previous regulations have all been revoked. Ordinarily gas oil would not come under the new regulation. But as there may be gas oils approaching the limit very closely, engineers would be well advised to have their oils tested for flash-point. The gas engineer who has written to us on the subject, with an oil-tank of some 450,000 gallons capacity, and which contains oil with a flash-point of 160° Fahr., is quite safe from any grievous consequences by not constructing an embankment or wall round the bottom part of it—so long as the flash-point of the contents of the tank continue to exceed 150° Fahr. Incidentally it may be mentioned that the Anglo-American Oil Company, Limited, have communicated the information that the gas oils imported by them over the past two months have had a flash-point above 150° Fahr. (Abel) and that now under all their gas-oil contracts they intend to deliver oil of this higher flash-point.

Security and Yield.

In the discussion of the question of capital-raising by statutory gas companies during and after the war, the point as to security has been raised. With so many investments looking particularly shaky at the moment, and with so much capital wholly unrealizable, the public are naturally, but probably temporarily, leaning towards investments that offer a good security. Mr. W. R. Herring suggests that the financing of gas companies might be done by largely increasing the proportion of loan capital; and in view of the substantial margin of safety at present given in the gross profits to mortgagees or debenture holders by all such companies, this, there is no question, could be done without actually impairing the security of the present loan capital or that of the ordinary stock. On the contrary, Mr. Herring believes it could be shown that even the cessation for some definite period of the issue of ordinary gas stock would inevitably enhance the value of that stock. The matter is further argued in a letter from him which is appearing in our "Correspondence" columns to-day. The point as to the improvement of the position of the existing ordinary shareholders to any material extent would, of course, depend on the rate of interest at which the loan capital is raised. The interest would have to be high just now; and it must not be forgotten that even in the normal times of recent years, low interest-bearing loan capital, with all the security offered by gas undertakings through the gross profits, has not proved a great attraction to the public, and the higher dividend-paying ordinary capital has been preferred, though the security has not been so good. The result has been that the values of the low-interest yielding loan stocks have been on the decline.

In Normal Times.

This condition of things is not by any means of modern inception. Messrs. A. & W. Richards, the well-known gas-stock auctioneers, in their report two years ago, on the trend of the investment markets, said: "With unusually high yields obtainable in other directions, it was only natural that buyers of gas stocks should look for a correspondingly higher return. Debenture stocks, as well as preferences, have again shown a disposition to recede in value in sympathy with all stocks bearing a fixed and low rate of interest." Even the old-established debenture stocks issued by the front-rank companies have had their prices forced down till upwards of 4 per cent. is the yield obtained by investors; and in many companies a higher yield than this has now to be offered to get the stock placed. There is not much use in normal times issuing debenture stock at a discount of 20 to 25 per cent. One might just as well at once offer a higher interest, and get par value for the stock. One advantage is that the market quotation looks better, and reflects itself on the other stock values of the same company. In these remarks may be found a cause why the statistical records of the industry show that, in recent years especially, companies with low-interest yielding loan capital, and with no power to increase the interest, have shown a preference for issuing ordinary capital. These remarks apply to normal times, when return has a greater attraction than security for a considerable body of investors. However, what is said here is quite by the way, and is not a complete comment on Mr. Herring's letter, the making of which comment is the privilege of Messrs. R. W. Cooper and Sons.

Concentration and Wholesale Dislocation.

When the London County Council approach Parliament with their electricity concentration scheme, they will not submit as evidence in favour of their proposals the incident of last Friday evening which called a sudden halt to practically all the tramcars running in North and South London, and put the cars themselves into such obscurity that in some places, owing to the darkened streets, they formed a standing danger to traffic. Only the vigilance of the car attendants and the police kept the streets free from accident through the stoppage. It was a shocking bad night, and the stranded passengers homeward bound were not altogether happy when the truth came to them that their journey would have to be resumed on foot in the slush and through the cheerless conditions of the evening. The cause of the widespread trouble was located at one point—in the switchboard gallery at the Greenwich generating station, where there was an explosion, and the cables connecting the generators to the switchboard were set on fire. It was hoped that the service would be resumed early on Saturday morning; but the suburban trains and the motor omnibuses were then doing the ordinary business of the trams. The incident is a warning against too great concentration; and several such incidents have been furnished by Greenwich and other large stations.

Engineering Employment and Wages.

Significant items of news, as showing the condition of employment in the engineering trades, were published at the end of last week. One of these had regard to wages, as to which the Amalgamated Society of Engineers made the announcement that no less than 25 per cent. of the home membership (or over 41,000 members) had during the present year secured increases in wages varying from 1s. to 3s. per week. These advances aggregate over £242,000 in time wages; while taking into account the corresponding advance in piecework prices, the earnings have been increased over £250,000 a year. So noteworthy and so general, indeed, is the prosperity of the workers, that the assertion is made that at no period in the history of the Amalgamated Society have so large a number of members secured such substantial advances in wages. Another equally illuminating item was the statement that a private conference was being held in Sheffield between representatives of the Amalgamated Society and kindred organizations and the Engineering Employers' Federation, so as to discuss the question whether more may not be done than is being done to cope with the existing abnormal pressure of work. There is, it is manifest, a shortage of skilled labour just now in the engineering trades, so many men having joined the Colours; and the problem before the conference was to decide in what way this skilled labour could best be organized to expedite the increased work which engineers throughout the country are called upon to do. One of the matters discussed was the advisability of the Amalgamated Society, as a temporary expedient, so relaxing some of their more stringent rules as to permit of the temporary introduction of less-skilled labour in certain departments. From what has so far transpired, it does not seem that any definite conclusions have as yet been reached; for after sitting for two days, the conference adjourned until this week.

Labour Organized.

The sympathetic strike has been much in evidence at the Law Courts during the past fortnight; for several days have been occupied in the Chancery Division over the hearing of a case of a highly instructive character. Apparently, too, it was one of some hardship, inasmuch as, though the Judge felt compelled to dismiss the case, he said that if he had had to decide it on the facts he did not think he would have found much difficulty in doing so in favour of the plaintiffs. Two men had been expelled from their unions, and it was with the object of annulling the resolution by which this expulsion was effected that the proceedings were brought. The men, who were treated by the unions in a manner which the Judge said "it was impossible to justify," were working quite contentedly at a time when the firm with whom they were engaged had a dispute with another trade union. A sympathetic strike was ordered; and plaintiffs refused to come out. They preferred to think and act for themselves, rather than submit without protest to the order to take part in so clumsy a method of bringing employers to terms as the sympathetic strike. Of course, if all the members insisted on acting according to their own individual ideas of what was right or expedient, there would at once be an end to trade unionism as we now know it. Hence the plaintiffs were invited to attend before a united trades committee, who took upon themselves to both fine the delinquents and expel them from their union. The two men urged that the committee had no authority to pass such a resolution, and that they did not get a fair hearing. In the course of his evidence in the real Court of Law (not the tribunal which had done its best to shut him out from work, by posting up notices to the effect that he was a blackleg), one of the plaintiffs said he was told by one man that if he could persuade the men in his line to come out "in sympathy," they could cause the closing of the works; but witness replied, "So that you can get your companions in and crush us out, the same as you have done at other places." Evidently trade unionism is not all brotherly love and contentment. The story is a sorry one, and accords ill with the love of liberty so dear to the heart of a Briton. The one really pleasant point about the tale is that after all the strike did not succeed.

In reply to an appeal made to the First Lord of the Admiralty on behalf of shopkeepers in the centre of Birmingham, praying for relaxation of the order relating to external shop lights, a letter has been received stating that it is not proposed to recommend any modification of the order.

PERSONAL.

Mr. S. R. OGDEN has tendered his resignation as Gas Engineer to the Corporation of Blackburn, and a meeting of the Gas Committee has been convened for its consideration. Mr. Ogden has been in the service of the department for 30 years—21 years in the capacity of Gas Engineer, to which post he succeeded on the retirement of his father, who was Manager to the old Blackburn Gas Company prior to the purchase by the Corporation. In the early days of Mr. Ogden's association with the works, the annual make of gas was 372 million cubic feet; while to-day it approximates 800 millions.

It was mentioned in the last number of the "JOURNAL" (p. 558) that Mr. HENRY FITZSIMON COTTON had been appointed by the Board of the Alliance and Dublin Gas Company to the position of Distribution Engineer to the Company. Mr. Fitzsimon Cotton was articled to the Liverpool United Gas Company, under Mr. Edward Allen, M.Inst.C.E., and was for a considerable period on the engineering staff at the Linacre works. For the past five-and-a-half years he has held the position of City Lighting Engineer, Gas Examiner, and Board of Trade Inspector of Meters under the Corporation of Dublin. As mentioned last week, the Public Lighting Committee unanimously asked Mr. Cotton to reconsider his resignation, and offered to recommend him for an increase of £100 a year; but, after fully considering the matter, he decided to resign, and will leave the Corporation service on the 1st prox. In their report to the Corporation on this subject (an extract from which was given last week) the Committee reviewed Mr. Cotton's work during his tenure of the position he is now relinquishing; and some additional particulars will be found in another column.

OBITUARY.

The death is reported to have occurred on the 9th ult. of Herr WILHELM JOSEPH GROSSMANN, who retired from the position of Manager of the Treves (Trier) Gas-Works in 1904, after having held it for over fifty years. He was Trustee for the Treves and Birkenfeld districts on the Gas and Water Works Industrial State Insurance Commission from 1885 to 1903.

General sorrow was felt throughout the Parish of Beath last Thursday when it was learnt that Mr. GEORGE TERRIS, the Clerk of the Parish Council and the Town Clerk of Cowdenbeath, had succumbed to an illness which began about a month ago. Deceased had been connected with the parish all his life, and had held various offices; one being that of Secretary and Treasurer of the Cowdenbeath Gas Company, Limited.

We regret to learn from an American contemporary of the death, on the 21st ult., after a very brief illness, of Mr. FOREST EDSON BARKER, the Chairman of the Board of Gas and Electric Light Commissioners of Massachusetts. Before taking this position, Mr. Barker for several years was a legal practitioner. In his capacity of Gas Commissioner he twice crossed the Atlantic, at the direction of the State Legislature, to study the lighting problem in European cities; and we had the pleasure of meeting him. He was a member of the Commission from its inception, which occurred as the result of the passing of an Act in 1885, whereby a Board of Gas Commissioners (the electric companies subsequently were added) was constituted, and took control of the operations of these utilities within the Commonwealth of Massachusetts. To that State is to be accredited the first Commission of this nature. In his official duties, Mr. Barker was brought into contact with most of the men prominent in gas affairs, not only in Massachusetts but throughout the country, for he was very regular in attendance at the meetings of all the principal Gas Associations.

The co-partnership movement and the South Metropolitan Gas Company have lost a staunch friend by the death of Mr. HENRY AUSTIN, whose earnestness and enthusiasm, both in his work for the Company, whom he served long and faithfully, and in his efforts to advance the welfare of the workers, endeared him to all who were fortunate enough to see something of his mind, and to understand his singleness of purpose. In a newspaper reference to Mr. Austin's death, we notice the remark, "Enjoying the confidence and esteem of those in authority, he also commanded the respect and confidence of his fellow employees." This assertion is perfectly true; and nothing better, or more in consonance with what his own wishes would have been, could be said of him—excepting, perhaps, it be to add that the passing of years served only to increase this confidence and this esteem. Mr. Austin, who died last Sunday week at his house in Blackheath, was born in 1843, and was for forty years in the service of the South Metropolitan Gas Company, from which he retired about four years ago. For a long period he occupied the position of Foreman Carpenter at the East Greenwich works. From the date of the introduction, in 1889, of profit-sharing by the Company, until the time of his death, Mr. Austin was one of the strongest advocates of co-partnership. At the first election of Employee-Directors, in 1898, he was returned to the Board; and this position he, by the votes of his fellow-workers, retained for twelve years—in fact, until his retirement from active work. All this time, he proved himself to be not only a good workman, but also a good Director.

M. DELAHAYE—M. MONNIER.

Deaths of M. Adolphe-Philibert Delahaye and M. Dimitri Monnier.

We greatly regret to record the death early this month, in his sixty-seventh year, of M. Adolphe-Philibert Delahaye, a Past-President of the Société Technique du Gaz en France, the General Secretary of the Syndicat Professionnel de l'Industrie du Gaz, and Editor-in-Chief and Managing-Director of the "Journal des Usines à Gaz," the official organ of the first-named Society. The sad event came quite suddenly, as only a few days previously deceased was attending to business, though the publication of the "Journal" ceased at the outbreak of the war. This was evidenced by the fact that we received from him a letter dated the 30th ult. bearing his signature.

M. Delahaye was a pupil at the Ecole Polytechnique in Paris, and he left during 1869. Next year he took part in the Franco-Prussian War as an engineer officer engaged in the defence of the forts on the east side of Paris, and was decorated with the order of the Legion of Honour. At the close of the war he devoted himself to various industrial affairs, and collaborated in the production of several technical reviews, in which he showed his brilliant qualities as a writer. Shortly after this he occupied himself with the subject of lighting, both by gas and electricity. He joined the Société Technique in 1882, was appointed Secretary in 1890, and was President in 1897 and 1898. In the former year he delivered a long and interesting Inaugural Address, an abstract translation of which appeared in the "Journal" at the time; and his subsequent contributions to the Society's "Transactions" have been noticed in our reports of the proceedings at the annual congresses. He never ceased to take an active part in the affairs of the Society. Consequent upon his election to the presidency, he became, in accordance with custom, an honorary member of the Gas Institute and subsequently of the present Institution; and he was personally known to some of the members, who met him on the occasion of the International Gas Congress of 1900.

On the formation of the Syndicat Professionnel de l'Industrie du Gaz in 1882, M. Delahaye was appointed the General Secretary; and he held the position till his death. It is not too much to say that he was the life and soul of this organization, all the Presidents of which found in him the most valuable and indefatigable of collaborators.

When the "Journal des Usines à Gaz" was started in 1875, by MM. Monnier, Servier, Rouget, and Jordan, it was not long before M. Delahaye became its General Manager; and, as already stated, he conducted it till his death.

M. Delahaye was associated with M. Henri Marquisan, a Past-President of the Société Technique and President of the Syndicat Professionnel, in the translation of Herr Schäfer's work on "The Construction and Management of Gas-Works." But more recently these two collaborators were engaged on a far different work—viz., as shown in the "Journal" for the 24th ult., in keeping up the supply of men and material in French gas-works in the present time of stress.

The funeral, on the 7th inst., was at the church of St. Jean-Baptiste, at Neuilly, where the deceased gentleman resided; and the interment took place at Loché (Saône et Loire). It was attended by as numerous a gathering of friends as circumstances permitted; many of M. Delahaye's colleagues in the Society being far from Paris, and some of his old comrades at the Polytechnique being in the Army. M. Delahaye rendered signal service to the gas industry; and his sudden removal is a great loss to it and a cause of keen regret to his friends. Having on many occasions had correspondence with him in his capacity of Editor of the publication already referred to, we can testify to the invariable courtesy which characterized his relations with us.

Two sons and a son-in-law of M. Delahaye are with the Army. The elder son is an officer of Marine, while the younger one is a lieutenant of the Chasseurs. The latter was wounded; but he has recovered and is about to return to the front. M. Delahaye's son-in-law is a lieutenant-colonel engineer in the Naval Artillery.

Unfortunately the Society have just lost by death another member in the person of M. Dimitri Monnier, who was admitted in 1876, and was one of the doyens of the gas industry in France. He was a pupil at the Central School of Arts and Manufactures, which he left in 1855. For several years, up till 1870, he was the Engineer of the Marseilles Gas Company; and he never ceased to take an interest in gas affairs. He was the consultant of many companies; his great competence, high intelligence, and remarkable scientific culture causing his advice to be very extensively sought. He was quite early led to the study of electricity, from the commercial as well as the purely scientific point of view; and he occupied with distinction the Chair of Industrial Electricity in the above-mentioned school. He retained till the last the full possession of his faculties; and his death will be keenly regretted by his numerous friends, as well as in the industrial and scientific spheres in which he moved, and in which he was so highly appreciated. M. Monnier's name will be remembered in connection with his formula for the flow of gas in pipes. His contributions to the Société Technique have been noticed in our columns.

THE GAS INDUSTRY AND THE WAR.

Very striking evidence is afforded by the number of the "Co-Partners' Magazine" of the Gas Light and Coke Company for the present month of the extent to which the call for men to assist in carrying on the gigantic struggle in which the country is now engaged has been responded to by the Company's employees. This issue of the magazine is appropriately called a "Double War Number," as it contains a list, occupying 28 large pages, of the men who joined the Colours. The names of those who have been killed or have died of wounds are marked by a cross; and the wounded, the prisoners of war or interned, and those who have returned to work as medically unfit, are all indicated by different letters. Seven of the men lost their lives, sixteen were wounded, three are prisoners, and fifteen have returned to work. There are a number of interesting extracts from letters from men at the front.

At the ninth annual meeting of the Newcastle-upon-Tyne and Gateshead Gas Company's Rifle Club last Friday evening, the Chairman (Alderman L. T. Penman, who presided in the absence of Lieut.-Col. W. H. Ritson) complimented the Company's employees on the number who had joined the Colours; no fewer than 338, out of a total of 1737, having volunteered for service. Sir W. H. Stephenson, the Chairman of the Company, was re-elected President. Mr. J. W. Ellis, one of the Directors, distributed the prizes, and joined Alderman Penman in complimenting the club on the way the members had responded to their country's call.

Mr. Ernest Hornsby Clarry, an Assistant Engineer under the Cardiff Gaslight and Coke Company, has been gazetted to a Commission in the Sixth Welsh Regiment, and has taken up his military duties at Swansea. Lieutenant Clarry has been in training with the Glamorgan Yeomanry since the outbreak of the war.

Mr. Norman Harrison, son of Mr. John Harrison (the Chairman of the Keighley Gas Committee), has been gazetted Second-Lieutenant in the Twelfth Battalion of the West Yorkshire Regiment, and is stationed at Windover, in Buckinghamshire. He has been transferred from the Royal Army Medical Corps, which he joined a few weeks ago.

The Davis Gas-Stove Company, Limited, of London and Luton, who have contributed over 400 men to the nation's call, have augmented their quota in the Chairman's son, Mr. Fred Price, who has joined the Ninth Lancers, Mr. John C. R. Davis, son of the late Mr. William Charles Davis, attached to the Essex Regiment, and Mr. C. E. N. Logan, the Advertising Manager, who was last week given a commission in the Leicestershire Battalion.

Messrs. Alder and Mackay have 62 men away from the works in Edinburgh with the Colours. One is Robert Scott, who was their representative in London and Birmingham, and nephew of Mr. Mackay. He is going into France with the London Scottish. Two of their Mr. Bennet's sons are also supporting the Army—one in the Garrison Artillery and the other in the "Dandy" Ninth (Royal Scots). Mr. John Anderson (the inventor of the firm's slot-meter attachment and the "A. & M." controlling apparatus for street-lantern work) has one boy away at the front, and another in training. When the war started, Messrs. Alder and Mackay stated that they would pay 10s. a week to the wives of men who enlisted, and 1s. a week for each child under school age. They kept this invitation open for two months; but when whisper of conscription arose they withdrew it.

The "Zeitschrift des Vereines der Gas- und Wasserfachmänner in Oesterreich und Ungarn" of the 1st inst. reproduces a State decree, which was promulgated on the 13th ult. to take effect from that day, with reference to the coal supply in Austria. It is intended to meet the extraordinary conditions which the state of war has produced, and provides that the Ministry of Public Works may take any appropriate measures in regard to the working of mines, the transport and trafficking in coal, and change of the destination of consignment, which will relieve the stringency due to the present lack of supplies. The miners may be compelled to work overtime, and on Sundays; and all coal stores, &c., are declared to be specially protected or favoured buildings. A penalty of £215, or imprisonment for six months, may be imposed on any person who fails to observe the terms of the decree.

At the last meeting of the Edmonton District Council, it was reported that a letter had been received, from the Tottenham District Light, Heat, and Power Company, with reference to the extinguishing of shop lamps by order of the authorities. The Directors of the Company had, it was stated, had under consideration the question of charges for high-pressure lamps on hire from the Company; and in view of the capital invested by the Company, and the depreciation thereon, they were of opinion that they would be justified in asking the consumers to pay a substantial portion of the rental of the lamps during the period of their disuse. In view, however, of the fact that this general extinguishing of lights was causing serious loss to tradesmen, the Company had decided to waive altogether, as from Oct. 1, any charge for the

hire of the lamps during the period they are out of use. This also applies to the rental of low-pressure lamps.

The Belgian Chamber of Commerce in London (whose address is No. 24, St. Dunstan's Buildings, St. Dunstan's Hill, E.C.), in a letter headed "War on German Trade in Belgium," draw the attention of English manufacturers to the splendid opportunity they have at present of making arrangements to be represented in Belgium. They say that among the good class of refugees there are a number who, before the war, acted for German firms, and who are now wishful to replace these makers by English manufacturers of similar goods. These refugees are here unoccupied, and would be very pleased to spend their time in acquiring the knowledge of the lines they will later be called upon to introduce. The writers of the letter place themselves at the disposal of manufacturers, to put them in communication with suitable applicants for such posts; and they further invite all employers who have vacancies for foreign correspondents, &c., to forward particulars of their requirements.

The question of the outside lighting of shops during the present restrictions was again the subject of a discussion at a meeting of the Battersea and Clapham Junction Traders' Association last Friday. The South Metropolitan Gas Company wrote saying that with regard to outside high-pressure lamps they had decided to allow the full amount of gas not used and half the rental and maintenance charges. Mr. Kerridge mentioned that the Gas Light and Coke Company and another Company who supplied gas at Wood Green were making no charge for maintenance or rental. Mr. Roche moved that a letter be sent to the South Metropolitan Company pointing out that the other Companies were making no charge; but Mr. Proudfoot pointed out that the two systems were worked differently. The Gas Light and Coke Company had no high-pressure mains in the locality. It was, however, agreed that a letter, as suggested by Mr. Roche, should be sent to the Company. In reply to a letter from the Secretary of the Association, the Town Clerk of Battersea wrote stating that the Electric Light Committee were prepared to make a reduction of 60 per cent. on contract charges in respect of hire and maintenance of outside lamps, on certain conditions. Mr. Proudfoot said the proposed charge by the Committee was disastrous, and suggested that a deputation should wait on them to endeavour to arrange better terms. Mr. Silverman remarked that the Ealing authorities were making no charge at all for maintenance. It was decided that a deputation should wait on the Committee, and that advice should be obtained on the question of the legality of continuing contracts affected by the war. A letter was read stating that information had been received from the Chief Commissioner of Police that full inside lighting of shops would be permitted until 6 p.m.

Bradford shopkeepers, who have for some time past been compelled to extinguish all outside lights at 8 o'clock every evening, in the general scheme of minimizing light for the protection of the city from attack from the air, have now gained a material concession in being permitted to maintain their outside lights until 8.30 on Mondays, Tuesdays, Wednesdays, and Thursdays, 9 o'clock on Fridays, and 10 on Saturdays, provided that they are hooded so as to reflect the light into the window, and not on to the pavement. Scarborough shopkeepers have been relieved of a heavy anxiety in relation to the Christmas season. The severe restrictions as to lighting under which all outside lights had to be extinguished and all shop-blinds and shutters drawn at 6 o'clock in the evening, have been relaxed to some extent; a new order having been issued that until, and including, Christmas Eve, shopkeepers will not be required to draw their blinds until 8 p.m., provided that their lights are shaded.

Reference was made in the last issue to the interned German workmen at Lancaster, and to the delay in inaugurating the Munich system of gas-making at Darwen. At the Town Council meeting, the Mayor moved the confirmation of a recommendation that the Town Clerk be instructed to take such action as he may deem necessary to assist Messrs. R. & J. Dempster to obtain the services of three of the German workmen. An amendment that the resolution be referred back was moved by Mr. Thornley, who urged that the men might easily do something which would be to the detriment of the installation after it had commenced working. He also contended that, in view of the position of the cotton trade, it was not necessary that the new installation should be started at the present time. Alderman Tomlinson said they knew the firm concerned were English, and that they were responsible to the Corporation for six months after the installation had started working. The Gas Committee's recommendation was not novel. There had already been cases where interned men had been released for urgent and specific purposes. The amendment was defeated by twelve votes to four. A resolution stood in the name of Mr. T. Duxbury, "that instructions be given to the Town Clerk to show to Messrs. Joseph Morton, Limited, of Halifax, the agreement or contract existing between the Corporation on the one part and Messrs. Dempster and the Stettin Chamotte Fabrik of the other part." He said that if the Mayor would undertake to see representatives of these firms and try to arrange matters, he would not move his resolution. The Mayor replied that he was willing to meet them; and Mr. Duxbury said he would arrange for the interview. An amendment was passed authorizing the Mayor to meet the firms' representatives.

TAR PRICES AND THE WAR CRISIS.

The Institution Proposal Fails.

Following up the notice given in the "Journal" for Nov. 24 (p. 408), as to the action recommended in the fixing of prices for "tar transactions during the war," we learn that the following circular has been sent to all gas undertakings in the kingdom.

Institution of Gas Engineers.

39, *Victoria Street, S.W., Dec.* 3, 1914.

Dear Sir,—I am directed to inform you that at a recent meeting of the Joint Committee representing tar producers and tar distillers, the following resolution was passed:—

> "The Committee regret to report that their efforts to fix the minimum price of pitch have failed; and therefore the proposed conditions for deliveries of, and payments for, tar during the war crisis are withdrawn. The Committee therefore recommend tar producers to make their own arrangements in regard to their tar contracts."

(Signed) Walter T. Dunn, *Secretary.*

GAS A SUBSTITUTE FOR SCARCE PETROLEUM IN GERMANY.

Particulars are given in the "Journal für Gasbeleuchtung" of the 28th ult. as to the measures that have been taken by the Municipalities of Berlin and Charlottenburg, and at Stargard, to facilitate the use of gas, in view of the increasing scarcity of petroleum in these cities. Other towns in Germany which have not already adopted similar measures are recommended to follow the example thus set them.

The announcement of the administration of the Berlin Corporation Gas-Works states that a new type of prepayment meter which does not provide for rental of lighting and cooking apparatus will be installed where needed. No deposit will be required of consumers using these new prepayment meters, through which gas will be supplied at the rates charged to ordinary consumers. Thus, in place of 23½ cubic feet of gas for a 10-pf. piece (= 1·2d.), which was the allowance through the old prepayment meters, the new meters will give consumers 26¼ cubic feet for a 10-pf. piece. Further, gas-fires will be installed free of rent.

The announcement of the administration of the Charlottenburg Gas-Works states that incandescent gas lighting is considerably cheaper than petroleum lighting; that the gas undertaking will make the gas connections to houses and flats at a reduction of one-third from the former tariff; that the payment of these charges will not be enforced until two years after the end of the war; prepayment meters will be installed free, and without a deposit being made; gas consumers with prepayment meters which allow 22 cubic feet for a 10-pf. piece will be given, rent-free, a three-ring boiling plate and three to five incandescent burners complete; "Bijou" burners, giving a light of from 20 to 40 candles, will be supplied as well as the ordinary incandescent burners; and gas consumers with prepayment meters which pass 24 cubic feet of gas for a 10-pf. piece will be given complete incandescent burners, pendants, wall brackets, &c., at a specially reduced rental.

The gas undertaking of the town of Stargard, in Pomerania, has announced that lighting burners up to three in number for living rooms, offices, workshops, &c., may be connected to cooking and heating gas supplies for a payment of 30 pf. (= about 3½d.) per month per burner. This arrangement has been made in order to facilitate the supply of gas for lighting purposes while the scarcity of petroleum (in Germany) due to the war lasts, because it would be difficult to obtain a sufficient number of meters for installation on all new lighting supplies. Advantage is, therefore, being taken to utilize for lighting supplies the service pipes and meters originally put in for the supply of gas for heating and cooking purposes only—the difference in the rate of charge of gas for the two classes of service being approximately maintained by the monthly levy on each lighting burner.

CONTAMINATION OF WATER SUPPLIES IN TIME OF WAR.

In the "Journal für Gasbeleuchtung" of the 28th ult. was a communication on this subject from Dr. Pfeiffer, the Chemist at the Municipal Gas and Water Works of Magdeburg.

He refers to the rumours which spread through Germany at the outbreak of the war, of water supplies having been poisoned by the enemy by the introduction of germs of epidemic diseases. Fortunately these fears proved baseless; but they have directed attention to the question of the generally increased danger of contamination of water supplies in time of war. The spread of disease by water, especially surface water, is a possibility which must not be ignored. The most certain way of combating the

disease germs in such circumstances is, he says, by the use of chloride of lime, as it can be applied at any time and in any works without previous preparation. Prejudice against this method is groundless, since 200 places in the United States treat their surface water supply with chloride of lime in order to sterilize it. It answers quite as well as ozone treatment, which is much more costly both in plant and operating costs. The chloride of lime decomposes in the water, and entirely disappears as such by the liberation of oxygen, which, in its nascent state, acts in precisely the same way as ozone.

Experiments were tried on the water supply of Magdeburg, which is surface water drawn from the Elbe and purified by filtration. The clarified Elbe water at one stage in filtration was found on the 4th of August to contain 1020 organisms per c.c. The chief experiment extended over four days, during which time 6,380,000 gallons of unfiltered water were pumped per diem. Chloride of lime was introduced at an early stage of filtration, at a rate corresponding with an addition of 120 grains of chloride of lime per 1000 gallons of water. The chloride of lime contained 36 per cent. of active chlorine, so that the addition corresponded with 43 grains of chlorine per 1000 gallons of water. The untreated water contained from 2820 to 2980 organisms per c.c., which were reduced by filtration, before the addition of chlorine, to between 850 and 2700 organisms per c.c. The addition of chloride of lime reduced the number of organisms to from 5 to 200 per c.c., and the pure water in the storage reservoir contained from 3 to 7 organisms per c.c. The action was entirely satisfactory on the first and second days, the few organisms—5 and 7 per c.c.—being completely harmless—*bac. mycoides*. The water distributed during and after this four days' trial was entirely free from any taste of chlorine. In fact, the smell of chlorine had disappeared at an early stage after the addition of the chloride of lime. The less satisfactory results on the third and fourth days, when the water after treatment showed 65 and 200 organisms per c.c. respectively, were due to cleaning operations which were being carried out on the filters. The process seems to be wholly satisfactory only when it is applied after the water has been completely clarified—that is to say, at the outlet of the rapid sand filters. It is better still to apply the chlorine treatment to the purified water; the sterilization being effected without affecting the potability of the water. The bacteria on the filters are not destroyed by water which has been previously treated with chlorine. The sterilizing action of the chloride of lime is only local. In order to determine the rate of action of the chlorine, a sample of clear water from the rapid sand filters containing 120 organisms was treated with chloride of lime in the proportion used in the large-scale trials, and was found to contain: After five minutes, 4 organisms; after ten minutes, 6 organisms; and after fifteen minutes, 5 organisms. It was evident, therefore, the full effect of the chloride of lime was attained in five minutes. A large-scale trial was made by the addition of a solution of chloride of lime in the same ratio to the contents of a clean water reservoir, and samples were taken from the supply taps at intervals of half-an-hour, and examined for taste and smell. No change in the character of the water due to this treatment could be detected at any time; the water before treatment being practically free from organisms. This experiment was made merely with a view to detecting taste or smell.

The author concludes that an addition of chloride of lime to Elbe water corresponding to 43 grains of active chlorine per 1000 gallons will kill off disease germs in the water within five minutes. This effect, however, can only be attained with certainty when the water treated is always clarified completely, which means that in water-works the addition must be made at the earliest after the rapid sand filters. As the action is only local, organisms in the subsequent fine sand filters are not killed, and hence it is advantageous to introduce the chloride of lime in the clean water reservoirs. This may best be done by adding the requisite proportion of a solution of chloride of lime of a strength of 1 in 100. The treated water is free from taste, and the cost of the treatment works out at 0·016d. per 1000 gallons.

ELECTRICITY SUPPLY MEMORANDA.

THOSE persons who have been raving about the time when electricity will be supplied to the householder for the smallest coin of the realm per unit have had their hopes dashed to pieces by Sir John Snell's carefully prepared argument in his Presidential Address to the Institution of Electrical Engineers, pointing to the impossibility of the materializing of the vision under the most favourable of circumstances. Naturally the plain truth is not palatable to the gentlemen who have been charging low sums for power, and ½d. for cooking and heating, and have been hanging-out the fact of so doing for public admiration. These gentlemen have silent tongues to-day, though their membership of the Point-Fives will help to keep the memory green of their administrative genius in unprofitable price making. Those who charge on the rateable value system, *plus* ½d. per unit, are in better case; but there is a good deal of the "undue preference" which is an abomination in the eyes of the law about the way the system works out. The report of Sir John Snell and an accountancy colleague on the working and the finances of the Southampton Electricity Department, to which reference has been made on one or two occasions, is claimed by some to have been a complete justification of the tariff policy of the department; but others think no further words or underlinings were required to make the report strongly condemnatory. Southampton is one of the electricity undertakings that supply for cooking and heating at a flat-rate of ½d. per unit. Sir John Snell, in effect, told the Committee in his report that in charging ½d. they had not so far done the undertaking any damage, but that they had better adopt a rateable value lump charge, *plus* ½d. per unit. This was a very kind and polite way of putting the matter—of saying how stupid the Committee had been, but now was the time to mend their ways.

The Prices—

And the Losses.

At the meeting of the Council a few days since, the charge for tramway energy was under discussion. Mr. Councillor Kimber then stated that the experts said that the average cost price of producing current for the trams, as distinguished from other branches of the business, is 1⅛d. per unit; and no transmission losses are incurred by the Electricity Committee—the current being measured at the generating station. For cooking and heating ½d. per unit is charged at present; and, the current being measured at the houses of the customers, the transmission losses are not borne by the Committee. With regard to current for power, there is a sliding-scale of 1½d. down to ¾d. per unit. In this case, too, the transmission losses are borne by the department. Now all the elementary theory and principles of charge that can be brought to bear cannot justify the difference between ½d. for such an intermittent purpose as cooking and heating and ¾d. up to 1½d. for power. But the experts said the average cost price of the power energy is 1½d. per unit. Mr. Kimber kept saying "according to the experts," as though someone else knew better. In proceeding to further "let the cat out of the bag," he remarked that the experts assert that on the heating and cooking there is a loss of 57¾ per cent., or £2546, and on power supplies a loss of 11 per cent., or £562. In other words, out of 2597 consumers, 853 are being supplied at a loss. Among other remarks by the same frank Mr. Kimber, he said the sliding-scale for power is so complicated that he doubted whether anyone on the Committee, without expert knowledge, could possibly work it out. Now here is a case of a Municipal Committee the Chairman of which acknowledges the incapacity of the members to weigh and judge the value of the tariffs brought before them; and a case in which, according to the calculations of the experts, the Committee were advised by someone to adopt prices which only result in losses. At any rate, this is the plain reading of Mr. Kimber's statement.

The War and Contract Lighting Charges.

The question of claims for rebates by consumers on the contract system has been before the Marylebone Borough Council Electricity Department. The claims, of course, refer to the reduction of illumination outside shops in consequence of the desire to obscure London to hide it from Zeppelins or other air-craft which, in these windy months, would not dare to cross the North Sea. In all cases, the hard-hearted Marylebone Committee have replied that no rebates can be made at the present time, and that the terms of the contracts must be adhered to. The General Manager (Mr. A. H. Seabrook) is reported to have made the wonderfully profound statement that, as the winter gets more advanced, and the proportion of lighting units increases, the diminution of street and shop lighting is having a greater effect on the total output per day. Recently the decrease has been between 12 and 25 per cent. per day in units. The nine largest consumers reduced their consumption by 52,000 units in October. This is one of the disadvantages of large shop connections in times of a European war, which fortunately is a somewhat rare occurrence. The question of the charge for the reduced street lighting has also been under consideration, on the October lighting account coming before the Council. Mr. Duncan Watson, who is an electrical contractor, used to be a severe critic of the Electricity Department; the critic has been punished for his sins by being placed in the chair of the Committee. The department, it is patent, is not very comfortably situated in view of the higher price unit losses occasioned by the darkening of London, combined with the low prices charged for units for other purposes. Mr. Duncan Watson pleaded for the terms of the public lighting contract being adhered to; and the price regarded as the minimum. We should have heard the Marylebone Council saying something unkind and very strong if it had been a gas or electricity company, and not their own Committee, with whom they were dealing. However, Mr. Watson promised that if—with an emphasis on the "if"—there was a good balance at the end of the financial year, the Committee would agree to give to contracts, where consumers had suffered in the matter of light, such favourable treatment as might be within their powers. We should prefer to get from the Committee at once all that is possible rather than wait on speculatively until the end of the financial year. What will happen then may be foretold pretty accurately.

Electricity Works and Loans.

In connection with the "business as usual" policy of the nation, and the urging of the Government that as much profitable work as possible should be carried out by local authorities and public companies to maintain employment, the electricity industry a short time since thought that

there was at Westminster a little incongruity between precept and practice. It was considered that the Local Government Board were discouraging expenditure by local authorities upon electric supply undertakings. Communication was made with the Board, who, as promptly as sedate and leisurely action would permit, denied the impeachment, and pointed out (this was on Nov. 21) that, far from discouraging expenditure on electricity undertakings, they had within the last month sanctioned loans of £150,000, £40,000, £17,700, £13,000, £10,000, and £8000, together with sums of minor amount. Now "Meteor" of the "Electrical Times" seems to think this generosity applies to generating-stations in full swing, but that the inception of a new concern is quite another matter. The Aylesbury Council, he states, have tried to obtain money from Lloyd's Bank at 5¼ per cent.; and "the sewage works were offered as security for the loan." But the bank seems to find certain legal difficulties in the way, and (at the time of writing) were not disposed to find the money. The sewage works deal with waste; perhaps the bank regards an electricity scheme for Aylesbury as waste. Anyway, Aylesbury has not yet been very fortunate over its new venture; and it does not seem very politic to saddle an undertaking such as will be the one at Aylesbury with a rate of interest so high as 5¼ per cent. But over this matter, some of the members of the Council have from the beginning more or less lost their heads.

Contrarieties.

In an allusion to the Yorkshire Electric Power Company's Bill, the "Electrician" says that "from the point of view of the universal use of electricity, it is highly desirable that such districts should be supplied with electric light." "Such districts" refer to rural areas; so that it is not intended to leave much territory to the gas industry. On the same page an editorial note commences dealing with "The State-Aided Dye Scheme." The note concludes with these words: "It is essential to the success of the scheme that the Government should give financial aid. It may be necessary to go farther than this, and to protect the industry from undue competition. In any case we trust the Government will not only take all necessary steps to ensure the revival of this lost industry, but to secure its future." What we should like our contemporary to discuss is how, if the gas industry is to be made practically useless by the universal adoption of electricity, the security of the future of the dye industry is to be preserved to this country. The raw material required for the industry is a product of the carbonization of coal. The aniline dye industry demands raw material at as low cost as possible, especially in competition with Germany; and to this end the carbonization of coal has to be conducted on the most economic lines. Therefore, the products of coal carbonization must be put to the most profitable and extended use; and to throw away gas of good calorific value is not to profitably use it.

Undue Preference and First Fruits.

The statement made in the "Memoranda" last week, on information received, that the South London Electric Supply Corporation, Limited, had withdrawn the rebate of ½d. per unit to householders who light their premises entirely by electricity, is confirmed by the receipt of a copy of the circular letter sent round to their consumers. It is dated the 1st inst., and reads: "I am directed to inform you that, the Corporation having been legally advised that the offer of a rebate of one halfpenny per unit on the terms of the Corporation's notice of the 23rd March last is *ultra vires*, the Board regret to announce that such rebate cannot be allowed as from this date." Why the Board should "regret" that they cannot continue an illegality is not at all clear; but evidently they do. There is an omission from the letter, and that is an apology for the ignorance or carelessness that induced the Board to do something which was *ultra vires*.

Bills and Orders.

The notices that have been given of applications to Parliament or to the Board of Trade for new electrical authority are not numerous. The electricity supply industry follows the reticence of the other sources from which Private Bill Legislation and Provisional Orders are usually derived. But if the electricity industry cannot point to a large number of promotions, it can claim the masterpiece of the session in the London County Council promotions to give effect to the electricity monopolizing scheme for London and an extensive environment. The second scheme which we anticipate will attract considerable opposition is that of the Yorkshire Power Company, who desire to supply in their enormous area current for lighting where there are no existing electricity distributors, and very generously, too, they want to save local authorities within the area from the expense, the annoyance, and the worry of having to apply for electricity supply powers on their own account. This is a very thoughtful scheme. It is, of course, a very foolish thing—so we take it the argument of the Power Company is—to have all these small electricity undertakings running-up costs and working expenses, when there is a much-tentacled concern like the Company willing to take it all off their shoulders. Last year the Company promoted a Bill for the same purposes; but it collapsed, owing to failure to comply with the Standing Orders. It is stated that the Bill will have much greater chances of success on this occasion than it would have had last year, as it is understood that "the Incorporated Municipal Electrical Association will not take up the same attitude of antagonism." But there are other people who will be antagonized—particularly those local authorities with electricity supply concerns who have their eyes cast on some of the electrically undeveloped territory which they hope will in due season act as tributaries to their own undertakings. Some of the Provisional Orders that are being promoted this session are for this very purpose—extension of supply area; there being very few proposals for starting new concerns. There are a small number of joint Electricity Supply and Traction Bills. Gas companies are still considering opportunities for a development of business through electricity supply. The Ascot Gas and Electricity Company are asking for additional electricity supply powers; the Ormskirk Gas Company are seeking authorization to the establishment of electricity works; and the Ilfracombe Gas Company desire to be authorized to supply electricity in the parish of Combe Martin.

No Joint Fittings Promotion.

The prescribed time has expired for publishing notices of Private Bill proposals; and there has been no intimation of the project for the promotion of a Joint Bill (as foreshadowed recently by one electrical contemporary) for conferring upon the municipal participants in the promotion powers to indulge in trading in fittings. This looks as though the Joint Bill suggestion made at the last meeting of the Incorporated Municipal Electrical Association, and which it is reported was subsequently taken up, has not matured satisfactorily. Probably those who interested themselves in the matter found there was not a sufficient number of fervent local authorities desirous of making the attempt to get these powers, in view of the douches of cold water that, in Parliament and in the Law Courts, have been given to the aspirations of local authorities in this connection, supplemented by the resistance of local contractors to any intrusion on what they regard as their preserves. If insufficient support is the reason for the non-appearance of the notice for a joint promotion, then those who are in a hurry to obtain the powers must go to Parliament individually. Otherwise, there is nothing for it but to patiently wait for the time when Parliament will say whether or not it is its will that the General Bill of the Municipal Electrical Association shall be placed on the Statute Book. The King's Speech at the opening of the new session of Parliament gave no promise of any unnecessary general domestic legislation being taken in hand this session, which is going to be conducted on the small instalment system, in view of war and finance claiming the almost undivided attention of the Government. It is therefore pretty evident that small fry like this well-seasoned, although still in embryo state, electrical measure will not be taken in hand this session; and more especially as it is likely to be the subject of much controversy within the walls of the parliamentary pile. If there is so much depending upon these powers, why do not the municipal authorities who want them go to Parliament on their own account? The fact that they do not do so must suggest to Parliament that the matter is not so exigent as some of the enthusiasts suggest. We quite realize that there are a number of municipal authorities who dare not individually apply to Parliament for these powers, but who would like to be able to say to their ratepaying opponents: "It is our duty to make use of the powers because they have been conferred by Parliament generally upon the electricity supply industry." The Bill is something behind which individual identity can be safely hidden.

Asking for Fittings and Wiring Powers.

Of course, there are some authorities who are not afraid to make individual application, nor sensitive as to what local opinion may be as to their action in attempting to trespass upon what the local contractors claim as their preserves. In the coming session, there are a few such local authorities asking Parliament for powers in connection with wiring, fittings, and hiring. The right to hire-out electric motors, and cooking, heating, and ventilating apparatus is sought by the Edinburgh Corporation, as well as authority to maintain show-rooms for electric apparatus. The Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board, which has not been a model of success for a venture of the kind, ask to be empowered to maintain show-rooms. In the Plymouth Corporation Bill, authorization is sought to the selling or letting on hire of electric fittings, to the fixing and repairing of them, &c. What the "&c." covers, we do not know. Desire is expressed by the Doncaster Corporation for the right to purchase, sell, let on hire, and repair motors and other electric fittings. The Dewsbury Corporation have more inflated requirements. They seek for power to sell, let on hire, and repair electric lamps, fittings, motors, &c., to provide and maintain show rooms, promote and hold exhibitions of electrical appliances, machinery, &c., and to promote the use of electricity by advertisement or otherwise. It will have been remarked that in the foregoing instances fittings, motors, and apparatus are mentioned, but not specifically wiring. In the South Shields notice, the Corporation are bolder; powers being proposed to supply and fix electric wiring. We can see the Electrical Contractors' Association sending an expeditionary force to Westminster to face these would-be municipal pilferers of the so-called rights of the local traders.

There is to hand from Messrs. Whittaker and Co. a copy of "Gas Supply in Principles and Practice," by Mr. W. H. Y. Webber. The published price of the work is 3s. 6d. net. A review of the book will appear in an early issue of the "JOURNAL."

STANDARD METHODS OF GAS-TESTING IN AMERICA.*

THE Bureau of Standards of the United States has issued a "circular" the purpose of which is to serve as a standard guide to the methods of testing gas distributed for illuminating and heating purposes. The methods described are intended primarily for use in official testing and in works laboratories "which are checked by City or State inspectors." The Bureau does not believe that "uniformity of method is always necessary in order that the results of a test be considered standard." The function of the "circular" is to collect and summarize the experience of gas chemists and inspectors in order to assist them in obtaining satisfactory results.

The "circular" is divided into two principal parts, which are followed by a brief bibliography and some appendices. The first part deals with the location and general equipment of a gas-testing laboratory, and the second part with apparatus and methods for testing. The treatment tacitly assumes that a public gas-testing station is necessary in order to ensure that the gas consumers' requirements are satisfactorily met by the gas undertaking. We should have preferred to see this major premiss proved at the outset. It may be that the interests of gas company and gas consumer are not unified in the United States as they are in the chief places of Great Britain, and that there is good ground for keeping strict watch and guard over the former lest it sell to the latter gas which is not "of the substance and quality demanded." If this is the case, it would have been well if the Bureau of Standards had stated briefly at the beginning of this "circular" the chief reasons why rigorous testing of gas supplies is specially necessary in the United States. It should have been demonstrated that such rigorous testing is likely to be attended by a gain to the consumer commensurate with the expenditure involved by it. The bulk, if not the whole, of this expenditure, whether incurred in the first instance by the state or a public authority or imposed directly on the gas company, must be borne ultimately by the gas consumer, and a few examples should have been cited to show approximately the sum that it represents per 1000 cubic feet of gas consumed in small, medium-sized, and large districts. The gas consumers would thus have been informed of the cost to them, or to the community of which they form a predominant section, of the city or state inspection of gas supplies which this publication of the Bureau of Standards is intended to foster.

With the cost—per 1000 cubic feet of gas—of this inspection before them, consumers would be able to judge whether a more economical and at least as efficient a method of safeguarding their interests could not be found in a co-partnership scheme between gas company and gas consumer. The sliding-scale system adumbrates such a scheme, and it should not be difficult to adapt it to American conditions, with such modifications as may be necessary to identify and bring into entire unison the interests of the gas company and the consumers. If the latter realized that an increase in the prosperity of the officers, directors, and shareholders of the company was attainable only by improvement and cheapening of the service rendered, there would be no further call for city or state inspection on behalf of the gas consumers, and official "circulars" on standard methods for use by city or state gas testers would become superfluities.

In cases, however, where city or state inspection of gas is still considered worth paying for, it is certainly desirable that it should be carried out in a fair and proper manner, and in so far as the "circular" of the Bureau of Standards may assist thereto, we welcome its appearance. As the methods of testing proposed in it are intended to be accepted as standard in the United States, they deserve exhaustive notice and examination.

In regard to the location of the testing-station, it is recommended that it should usually be at about one mile from the gas-works, central, and supplied from a trunk main. For a chief testing-station, four separate rooms are considered desirable, to serve as: (1) Inspector's office, (2) photometer and calorimeter room, (3) chemical laboratory, and (4) meter-testing shop. The chief purpose of the office appears to be to contain demonstration meters, gas-burners, &c., by the aid of which the inspector may help inquiring consumers to get the best value for the money they expend on gas. Obviously a gas company will welcome the establishment of such a room if only consumers can be persuaded to visit it; but it is certain that in ninety-nine cases out of a hundred the city inspector will be less competent to advise consumers on the choice of burners, the cause of excessive consumption of gas, &c., than would a member of the technical staff of the gas company.

There is nothing of special importance in the suggestions for the general disposition of the photometer and calorimeter room and the chemical laboratory. The photometer room naturally must have good continuous ventilation and equable temperature. In some respects the Bureau of Standards lags behind English practice. For instance, it prescribes, or at least allows, a consumer's meter on the gas supply to the testing-room, which is certainly undesirable. Also, a gas "blow-off" is to be provided in order that the gas in the service and the meter can be quickly replaced by other gas direct from the main before a test is made. The customary alternative to such a blow-off is said to be the lighting of several burners in the testing-room itself, whereby naturally the air of the room is heated, and the ensuing tests consequently are of dubious worth. Clearly the plan adopted in well-equipped photometer rooms in this country, of keeping gas burning continuously at the foot of a ventilating shaft, is the better way of avoiding the risk of testing stale gas, and at the same time ensuring good continuous ventilation of the room. Even if the room is used at only rare intervals, this arrangement answers better than any other. But, instead of burning the gas continuously, it suffices to light it not less than an hour before starting a test. If the ventilating jets aggregate a consumption of fully 50 cubic feet per hour, a properly-laid service pipe will be cleared of stale gas and the ventilation of the room will be established in this time.

Meter-testing stands apart from gas testing; and it is admitted that the meter-testing shop is best located at the gas company's meter-repair shop, though it is suggested that a small testing shop should be attached to the inspector's office for the purpose of testing "complaint" meters. This suggestion is made in order to avoid the suspicion that the company could influence or control the results of such tests if they were made at its meter shop. Why does the Bureau of Standards propose to pander to the scruples of people who profess to entertain such an unreasonable suspicion of the gas company? Does not the Bureau realize that it is thereby casting on the inspector the reflection that his certificate of test of a meter may be influenced by his proximity to the company's premises at the time of making the test. Let the inspector be above suspicion, and it would become unnecessary to regard the situation of the station where he tests "complaint" meters from any standpoint other than that of its convenience and equipment for the work of testing.

The following axioms are laid down in regard to apparatus and methods: (1) Such accuracy is necessary as will assure the public that any deficiency which might cause loss or damage will not pass undetected, and as will protect the company from undeserved penalty, (2) convenience of apparatus or method should be second only to accuracy—the simplest procedure giving satisfactory results is preferable—and (3) initial or operating expense should not be unduly cut-down at the sacrifice of accuracy or convenience. The simplest method of giving correct results is the most economical in the end.

In discussing the measurement of gas, the Bureau gives a text-book summary of the effect of conditions on gas volume, and tabular numbers similar to those issued for many years past by the Gas Referees, but for a range of temperature 60° to 99° Fahr., instead of 40° to 84° Fahr., and omitting atmospheric pressures above 30·5 inches (the Gas Referees' table extends to 31 inches). The difference between the climatic conditions of London and many parts of the United States accounts for the difference in range of the two tables. The American tabular numbers, however, are calculated from a formula which actually differs from the Referees' formula $n = \frac{17{\cdot}64\ (h - a)}{460 + t}$ in that the constants are 17·62 and 459·4 respectively, though the form in which the formula is given is clumsier than the Referees'. Whether as a consequence of the small variation in the constants of the formulæ or of different values having been taken for a (the tension of aqueous vapour), the figures in the two tables differ by one unit in the third place in perhaps a score of instances. We have checked by the American formula only one of these instances, taken at random—viz., the tabular number for 29·8 inches and 68° Fahr., which the Gas Referees give as 0·972 and the Bureau as 0·973. When the tension of aqueous vapour at 68° Fahr. given in the table quoted in the Bureau's "circular" is used in the American formula, the figure is actually 0·97237. So it is impossible to understand what ground the Bureau has in this instance for departing from the Referees' figure of 0·972. Owing to the almost universal adoption of the Referees' table wherever gas volumes have to be corrected to the standard conditions of 60° Fahr., 30 inches, and saturated, the Bureau could only have been justified in putting forth a rival table if the differences were all in the direction of making the latter more accurate. In the one instance in which we happen to have tested the new table, it is shown by the Bureau's own formula and data to be less accurate than the generally-accepted table of the London Gas Referees. The matter is a very small one. But in such a table accuracy and uniformity are more estimable than originality; and we trust the Bureau will, therefore, see its way to withdraw its new set of tabular numbers.

The Bureau proceeds to give a description of dry gas-meters and experimental wet meters. There is nothing original in these descriptions, or in the directions given for the proving of experimental meters.

The next section of the "circular" deals with the measurement of heating values. Various types of calorimeter have been described and criticized by the Bureau in an earlier "circular." There is, however, in the present little volume a general reference to the various types of gas-calorimeters, which are divided into five classes—viz., (*a*) The Berthelot bomb type, which gives the total heat of combustion at constant volume; (*b*) the Regnault and Julius Thomsen types, in which the gas is burned in a combustion chamber and the products of combustion give up their

* "Circular of the Bureau of Standards, S. W. Stratton, Director, No. 48. Standard Methods of Gas-Testing." First Edition, Issued Aug. 1, 1914 Washington: Government Printing Office; 1914.

heat in passing through a worm immersed in the water of the calorimeter; (*c*) the comparison type, such as the Parr calorimeter, in which the rise of temperature produced by the combustion of a given volume of the gas under test is compared with that produced by the combustion of the same volume of a gas of known calorific power [the Strache calorimeter is akin to this type]; (*d*) the water-flow type, of which the Junkers and Boys instruments are the best known; and (*e*) calorimeters depending on the indications of a thermometric device heated by gas burned at a constant rate as controlled by a pressure regulator or similar appliance. The Féry calorimeter, the Sarco recording calorimeter, and the Simmance-Abady calorgraph belong to this type. Calorimeters of this class generally require calibration by comparison with a standard, and they usually only indicate net calorific values.

The principles of water-flow calorimetry are briefly stated; and there is then a section on the choice of calorimeters, which will not be of very great use to English readers, since of seven flow calorimeters referred to, only two now come into consideration at all for official testings of the calorific power of gas in this country. It seems doubtful, from the observations offered, whether any one of these calorimeters has been used by the Bureau of Standards with the equipment and accessories with which it is used here. The Bureau dislikes the practice of taking the supply of water for the calorimeter direct from the water-main, although in this country the practice is found convenient and on the whole satisfactory. In most large towns the temperature of the water from the main varies less than that of water in a tank in the room, and has the advantage of being, on nine days out of ten, at a lower temperature than the room. In the directions given for operating flow calorimeters, the tester is directed to clear the gas connections from old gas by the use of the "blow-off" to which we have already referred, or by lighting several burners. We have pointed out above that the procedure which is general in this country is far preferable. The observations of calorific power are restricted to two turns of the meter, instead of the four turns which are commonly taken here. Special directions are given for operating the Doherty and the Parr calorimeters, neither of which is well known on this side of the Atlantic.

The "circular" next deals with the determination of candle power by means of the bar photometer of the open or closed type and a portable form of the former. The table photometer is but rarely used in the United States. Since the candle power of gas supplies in America is generally higher than in this country, the Carpenter, or "Metropolitan" No. 2 argand, burner is used comparatively little in official testings there. Flat-flame burners are more common; the Bray No. 7 slit-union burner being probably that which is most used. The Bureau states that "for gas below 18 or 20 candle power, the 'Metropolitan' No. 2 argand gives the highest values." Nevertheless "the Bureau prefers the open-flame gas-burner." Why does it prefer to depreciate the value of the gas? As regards standards of light, it is observed that "candles are simple, cheap, and portable, and are therefore well suited for use where accuracy is not required." There is a delicate humour about this statement, which gas managers who have had to submit to penalties in respect of deficiencies in illuminating power ascertained by testings with standard candles, will appreciate to the full.

It is stated that the Harcourt pentane lamp is now used in the United States more than any other standard except candles. A lamp with pentane as the fuel is, of course, somewhat objectionable for use in the hotter districts of America; and it does not appear that the Bureau has tried the expedient, which we understand has been adopted in India, of substituting hexane for pentane. The Elliott kerosene lamp, which is used to a considerable extent, is probably the best of all wick standards of light, and is very convenient for use where the pentane lamp is not available. The effect of atmospheric conditions on flame standards is referred to, and suggestions are made for the correction of the light of the standards for fluctuations in atmospheric pressure and humidity. The Bureau apparently contemplates waiting until its own investigations on this subject have been completed before putting forward a definite formula or scale for effecting these corrections. The work of Liebenthal on the Hefner lamp, and of Mr. Paterson and Messrs. Butterfield, Haldane, and Trotter on the Hefner and Harcourt lamps does not appear to have been accepted by the Bureau. Indeed, no reference is made in the "circular" to the latest determinations in this country of these corrections.

A diagram in the appendix to the "circular" gives curves for the variation of candle power of pentane lamps with humidity and barometric pressure; but it is not stated on whose investigations these curves are based. Thus it is impossible, except by comparison with the curves or formulæ given in the reports of the investigators already mentioned, to say whether the diagram put forward by the Bureau is of any real value. The authority for it should certainly have been stated.

The next section of the "circular" relates to the determination of impurities in gas. The impurities which come into question are sulphuretted hydrogen, sulphur in other forms, and ammonia. The first of these is the most important; and we regret to see that the Bureau is proposing to impose on American gas undertakings a form of test for sulphuretted hydrogen which is clearly more rigorous than that now prescribed by the Gas Referees. Both tests avoid direct impingement of a jet of gas on the test paper, the effect of which is to concentrate all the lead sulphide producible from the sulphuretted hydrogen in the gas on a tiny area. But by way of concentrating the lead sulphide on a relatively small area of paper, the Bureau uses only one slip of test paper against the six slips prescribed by the Referees. In both tests the gas is passed through the apparatus containing the test paper at the rate of about 5 cubic feet per hour; but whereas the Referees give an exposure of three minutes, the Bureau suggests one minute. Thus by the Referees' test, the lead sulphide produced by $\frac{1}{4}$ cubic foot of gas is spread over six slips of paper; by the Bureau's test that produced by $\frac{1}{12}$ cubic foot of gas is localized on one slip. That is to say, from gas of the same degree of purity, twice as much lead sulphide is deposited on each slip of paper by the Bureau's test as by the Referees' test. The risk of discoloration of the paper being observed and the presence of sulphuretted hydrogen being reported are therefore very much greater if the Bureau's proposal is adopted. On what grounds, we wonder, does the Bureau consider that American gas undertakings should be subjected to a more rigorous test for sulphuretted hydrogen than the London Gas Companies? Not even the most rabid opponent of gas interests has ever suggested that such a mere trace of sulphuretted hydrogen as might escape detection by the Referees' test can be harmful to anyone, consumer or otherwise. Presumably, however, the Bureau of Standards has a keener perception of the mischief which infinitesimal traces of sulphuretted hydrogen may produce on combustion.

The determination of the total sulphur in gas may be made in a number of ways; but for official use the Bureau considers that the Referees' method has some advantage over the others. It says that the "general use of the Referees' apparatus has been justified by its simplicity, convenience, and accuracy; and although the accuracy obtainable with this, as well as with other forms, has often been over-estimated, yet the results are quite satisfactory for all commercial or official work if reasonable care is observed in the selection and operation of the instrument." With this expression of views we are in general agreement; but we differ from the Bureau as to what constitutes "reasonable care" in the selection and operation of the apparatus. It is evident from the illustrations of the Referees' apparatus given in the "circular," and the suggestion which is made that the glass marbles in the condensing tower should be supported by a porcelain or glass plate, that the importance of a large throughway which will admit of a slow yet ample flow of air has not been realized by the Bureau. Many a gas manager has been perturbed through inconsistent returns of sulphur testings, which have ultimately been traced to a set of test apparatus having had a much constricted air-way. The Bureau should state the dimensions of the apparatus or a minimum cross-section of throughway, in order to assist a tester in exercising reasonable care in the selection of his sulphur test apparatus.

Dr. Elliott's sulphur test apparatus acts on the same principle as the Referees' apparatus, but has two condensing towers connected in series, and can therefore be used safely at a higher rate of combustion—*i.e.*, 1 cubic foot to 1·2 cubic feet per hour. Thus a satisfactory test may be made in shorter time with it than with the Referees' apparatus. There is scope for this or some similar modification of the Referees' test, especially for works use.

Various forms of ammonia absorption apparatus are described in connection with ammonia testing. The general question of whether there is any need for ammonia tests for official control purposes is not discussed by the Bureau. We merely observe that, after years of ammonia testing in this country, it was at last realized that gas companies attached so much value to ammonia that they did everything in their power to remove it completely from gas. It was sheer waste, even of an official gas-tester's time, to set him to make tests for ammonia, since no appreciable quantity of it was ever found, except on rare occasions when the scrubbing plant failed through unavoidable cause or accident which exonerated the gas company from blame or penalty.

There is a short account of pressure gauges, and a fairly long report on meter-testing, which relates both to the standardizing of consumers' meters and the proving of experimental meters. The Bureau sees some advantages in the use of oil instead of water as the confining liquid in meter provers, and is now studying this question, including the relative merits of different oils for the purpose. Similarly in the near future a careful investigation of methods of gas analysis is planned by the Bureau. We would here observe that two or three years' practice in gas analysis exclusively is necessary to render an assistant who is otherwise well qualified fit to undertake such an investigation.

The "circular" concludes with a note on the determination of atmospheric humidity. It is stated that with ventilating hygrometers the air should move past the wet bulb at a rate of at least 3 metres (say, about 10 feet) per second. For calorimetric work, readings should be made to the nearest one degree Fahrenheit; but for photometric work more accurate observation of the two temperatures is considered desirable.

The "circular" should be studied by those who are already enveloped, or are likely to be enveloped, in a mist of official gas-testing regulations. They may learn from it methods which are being proposed for making testings, the primary purpose of which appears to be to perpetuate the sense of mistrust of gas companies which sliding-scales and co-partnership schemes are fast abolishing in this country. The Bureau of Standards has made a conscientious and painstaking effort to assist the official gas-tester in his work; but we should have preferred to see the Bureau suggest ways and means by which the work could be dispensed with without detriment to the interests of the gas consumer.

A NEW VERTICAL RETORT INSTALLATION AT OSSETT.

Opening Ceremony last Thursday.

THE official opening of the new intermittent vertical retort installation at the Ossett Gas-Works took place last Thursday afternoon. The new plant has superseded the old horizontal system, and has been supplied by Messrs. Leech, Goodall, and Co., of Hunslet, Leeds. The actual cost of the plant is about £18,000; but this figure would be increased to £26,000 when the drainage system, the new railway siding, the boundary walls, &c., are taken into consideration. There was a large gathering at the works for the official opening.

Prior to the actual opening, Mr. A. E. Mottram, the Engineer and Manager of the works, briefly explained the workings of the new plant. Subsequently,

The MAYOR (Councillor S. B. Stead) said it gave him very great pleasure to preside over the ceremony that afternoon. He had to call upon Mr. Harvey Robinson, the ex-Mayor of Ossett, who had been Chairman of the Gas Committee for ten years, to perform the opening ceremony. Ten years was rather a long time for one person to occupy an important position such as Chairman of the Gas Committee; but he thought honour should be given where honour was due, and believed that they were conferring an honour that afternoon upon a gentleman who was worthy of it. He was pleased to say that, during the extensions of the gas-works, there had been no accident whatever. He believed, also, that there had not been the slightest friction between the contractors and the employees. He further understood that between the manager of the gas-works and the contractors and workmen there had not been the slightest friction. He did not propose saying anything further at the moment, except to call on Mr. Councillor Robinson to perform the opening ceremony.

Mr. ROBINSON said he appreciated far more than he had time to express the kindly expressions regarding himself which had been made by the Mayor; and he appreciated also the honour which the Gas Committee had conferred upon him in inviting him to perform the opening ceremony. He was not sure that a formal opening such as the one they were having was essential to the success of the gas undertaking. If it was, his hopes would be very small indeed, as he could only promise them a blundering way of starting the new works. They were cherishing large expectations in regard to this plant in the future. They in Ossett were not the pioneers of the establishment of this system of vertical retorts. There were those who had adopted the system prior to Ossett; and it was upon their experience that the Ossett Gas Committee had been guided. He could only hope that in Ossett they would be able to repeat the success which had attended the vertical-retort systems elsewhere, and perhaps improve upon the results which had previously been attained.

Mr. Robinson then discharged three retorts with the remark: "Wishing the system every success."

Afterwards the company mounted the stairs and saw the retorts being charged; and, in honour of the occasion, Mr. Robinson intimated that the Corporation were paying all the workmen at the gas-works double wages for the day.

Before giving a detailed description of the new plant, it may be mentioned that the increasing demand for gas at Ossett during recent years has become so great that the limits of the existing plant were reached, and it was therefore absolutely necessary to decide in what way the plant should be increased. The present plant is crowded together, and does not lend itself to extension in any way; moreover, in view of the very great strides that have taken place during the last few years in methods of carbonizing, it appeared to the authorities that to extend the present horizontal bench would in any case have been bad policy. A Sub-Committee of the Gas Committee visited a number of works to inspect the various systems, and they were forced to the conclusion that vertical retorts would give them the best results, in so much as they were guaranteed an increased yield of gas per ton of coal carbonized, lower labour costs, better coke, tar, and liquor, and freedom from naphthalene, which on the old plant was a constant source of trouble. The final choice of the Gas Committee was for the intermittent type; and the contract for an installation on this system was placed with Messrs. Leech, Goodall, and Co., of Leeds. The Corporation had ample ground space scheduled for gas manufacturing purposes adjoining the old works; and this, being a green field, was admirably suited to their requirements, and allowed for future extensions. An additional advantage of the extension site is that a siding has been laid from the main line of railway, so that coal may be brought direct to the coal-store in railway waggons—all coal for the old works having to be carted. The contractors carried out the foundation work, which was commenced on Jan. 28 this year. The first charge of coal was put into the retorts on the 17th ult.

THE VERTICAL RETORT-HOUSE AT OSSETT IN ITS EARLIER STAGES.

Description of the New Plant.

Messrs. Leech, Goodall, and Co. have forwarded the following details as to the plant they have erected at Ossett.

COAL-STORE.

The coal-store is situated alongside the retort-house, and on the same level. The store is at present an open one; but foundations have been arranged suitable for taking the walls, should these be built later. The floor is covered with concrete; the siding being laid down the centre of the store.

RETORT-HOUSE.

The retort-house is of modern type, consisting of steel-framed structure of girder stanchions, horizontally braced with channels and girders, divided into suitable panels, which are filled-in with 4½-inch brickwork. The side wall dividing the house from the coal-store is built of solid brickwork, 18 inches thick. The structure is rigidly stayed to the buckstays and girder work of the bench; the stanchions of the side wall above the retort-bench also forming the supports for the overhead hoppers.

The roofs are covered with slates secured to angle steel purlins, and louvres are arranged along the top of the main roof and the lean-to roof on the coke discharge side. Ample light and ventilation is provided by windows of the centrally pivoted type, which are arranged in the framework. There is also a line of glazing along the roof on the producer side. Large openings, to give access to the retort-house and admit light, are provided in the side and gable walls, covered with steel sliding doors.

RETORT-BENCH.

The vertical retort-bench consists of four beds of 18 retorts, or a total of 72 retorts, having a capacity of 950,000 cubic feet per

twenty-four hours. Each of the beds measures 15 ft. 6 in. between the division walls, 20 ft. 10 in. from back to front of the brickwork, and 22 ft. 6 in. from the ground line to the top of the retorts. The retorts are 13 ft. 3 in. long, tapering from 9 in. by 22½ in. at the top to 14½ in. by 27½ in. at the bottom. The division walls are 14 in. thick; the end piers being 2 ft. 6 in. thick.

On the producer side the bench is built up from the floor; but the setting itself is carried on cast-iron plates about 9 feet above the floor level to allow of the coke being discharged underneath. The cast-iron plates are supported on structures of heavy joists carried by the main buckstays and stanchions fixed at the back of the producer. Each setting is provided with its own producer, which is the full height of the bench and is built central. A feeding door is arranged at the top of the producer and double furnace doors at the bottom, having step bar-grates, which entirely do away with clinkering. The ordinary operation of pricking the fire-bars every twelve-hours is sufficient to keep the furnace working properly and the clinker from gathering; this being done without removing the fire-bars.

The producer gases are taken off at the level of the floor of the retorts into a chamber, from which they are regulated to the setting by means of seven nostrils, each fitted with a regulation damper. The regenerators are arranged on each side of the producer, and are formed of three vertical passages—two for waste gases and one for secondary air. The waste gases enter the regenerator at the top of either side of the producer, descend in the two outer passages, and are collected at the bottom in one flue, which is connected with the main flue; the primary air, before going to the producer, being preheated by passing through the two lower runs of the regenerator. The secondary air enters the middle passage at the lower end of the regenerators, and passes upwards to the top of the setting into a chamber, where it is split up, and enters the setting on either side of the seven gas nostrils before mentioned.

The retorts are arranged with flanges carrying flooring tiles, at different levels, to regulate the flow of the gases from the combustion chamber, which is formed at the lower part of the setting, to the waste-gas outlets at the top; and these flows are arranged with dampers to enable the heat to any part of the setting to be under complete control.

The main flue extends the full length of the bench, and is connected to a chimney made of steel, and lined to its full height with fire-brick. The chimney is situated at a distance suitable for extending the bench by an additional two settings. The main flue is built with the inlets for waste gases from the settings temporarily bricked-up.

The bench is efficiently braced with heavy main buckstays, and intermediate bracing secured by tie-rods. The main longitudinal tie-rods on the top of the bench are fitted with four volute springs, to allow for expansion.

The bench fittings are of the type which is usual with this class of intermittent vertical retorts; each retort being provided with a cast-iron mouthpiece with self-sealing lid. The retorts are set in rows of three; and the top mouthpieces forming one set are connected by means of branches leading into one common gas outlet. The gas is taken off by cast-iron pipes fixed with a slight fall towards the retorts, and connected to dip-pipes by special elbows having expansion sockets and flanged cleaning covers.

The hydraulic mains are of special design; a separate main being provided for each bed. The body is formed of steel plates riveted to a strong angle frame, and is fitted with six cast-iron self-sealing inspection doors, which allow of the pitch pans placed under each dip-pipe to be withdrawn during gas making.

Each hydraulic main is fitted with a dwarf tar-tower; and the main is flushed at each charge with liquor from a tank placed on the cross girders at the top of the hoppers. The tar is taken off by a 6-inch main running to the end of the bench, where it is sealed in a bench fitted with a perforated plate which catches any solid matter carried by the liquor flushing the mains.

The gas-main is 24 inches diameter; and a Braddock retort-house governor is installed.

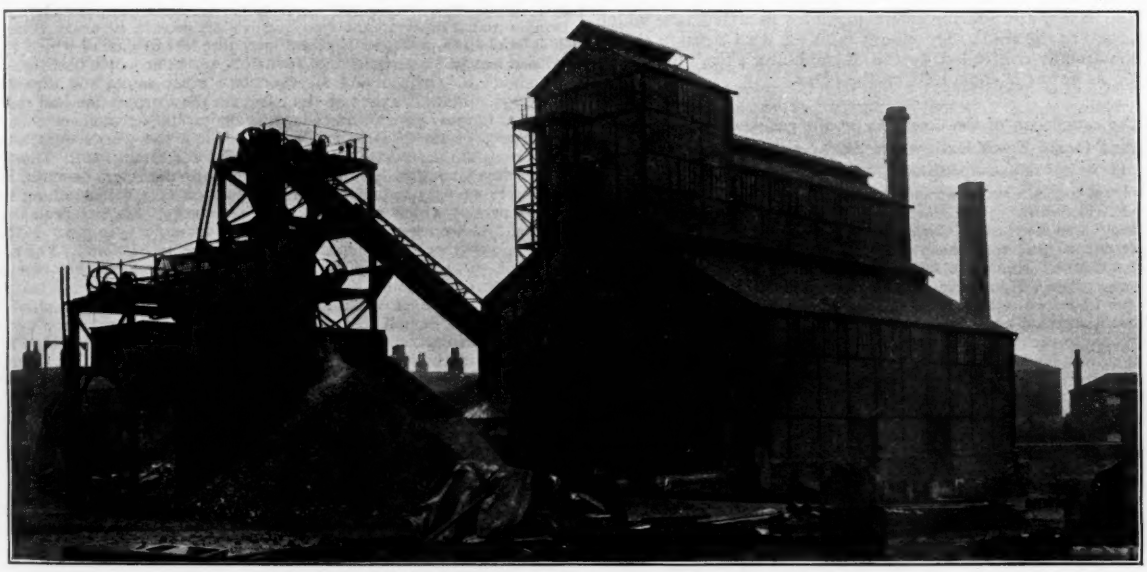
The bottom mouthpieces are fitted with self-sealing lids, and are coupled in sets of three. The lids are opened and closed by hydraulic power; a ram being fixed on the front of each bed controlled by a four-way valve from a convenient position. This gear is extremely simple; and, as there are so few working parts, there is very little danger of anything getting out of order. The coke is discharged into the coke conveyor by a travelling shoot which runs on a track laid on the floor.

Steaming the Retorts.

The retorts are charged every twelve hours, but as the charge is completely carbonized in ten hours, they are steamed before the charge is withdrawn. The gas thus made is produced at a minimum of expense, and the quality of the gas can be regulated as required. Each retort is provided with a ½-inch diameter pipe, coupled-up to a main steam-pipe running along the bench, fitted with a valve. Staircases and platforms, constructed of chequer plates with hand-railing, are provided to all parts of the installation where required.

Coal-Handling Plant.

The siding to the coal-store passes over the receiving hopper, into which the waggons are discharged. A hydraulic ram is installed for discharging waggons with end doors; a special feature being that this is of the swivelling type, fitted with arms which allow the ram to swivel and accommodate itself to waggons of varying wheel-base, without any lateral strain coming on the ram. The ram is operated by a valve conveniently placed near the hopper. An automatic jigging feeder, with adjustable stroke, is fitted under the outlet of the hopper, which feeds the large coal direct to the breaker and bye-passes the small to the elevator boot. The pit in which the breaking machinery is fixed is of ample size, so that the attendant may get at any part of the plant without danger. The pit is constructed of brickwork with a concrete bottom, having a bitumen lining. The lining is protected by 9 inches of brickwork all round, and renders the pit absolutely water-tight.



THE VERTICAL RETORT PLANT AT OSSETT AS WORKING.

The coal, after being broken, is elevated to a small hopper placed overhead, by means of an 18-inch cased-in elevator, from which the push-plate conveyor, extending the full length of the storage bunkers, is fed. The hopper at the elevator head is also fitted with a separate shoot, so that the storage hoppers may be filled from it by means of waggons, in case of breakdown to the conveyor. The hydraulic hoist also forms a duplicate coal plant, as waggons containing coal may be taken up by this means to the hoppers. The coal plant has a capacity of 40 tons per hour; so that the whole of the coal required each day may be taken up during a few hours of the morning shift.

A Robey steam-engine of 30 H.P. is installed for driving the coal plant. The engine-house is placed at the end of the retort-house, and is a separate building of red brick with slated roof. The floor is red tiled, and the walls are built with glazed brick for about 3 feet high, which enables the house to be kept perfectly clean.

Coke-Handling Plant.

The coke from the retorts to the yard is handled by means of a coke conveyor, which is level in the retort-house and inclined

outside. The conveyor discharges into a revolving screen which screens to four sizes. The breeze, nuts, and small coke are discharged into separate compartments built of brick, and the large coke is deposited in a bunker, from which railway waggons may be loaded direct. A separate shoot is fixed so that the coke, without being screened, may be dropped in the yard for storage. The chain is of the De Brouwer type, and the trough is built of steel with renewable side lever plates and cast-iron bottom plate. Automatic quenchers are provided for quenching the coke in the trough. These come into operation as the coke passes underneath; being automatically closed when the coke has passed along the trough.

The coke-handling machinery is driven by a 20-H.P. steam-engine housed in a separate building, which is of the same design as, and matches the construction of, the retort-house and coal-plant engine-house.

Hydraulic Hoist.

The hydraulic hoist for raising waggons containing coke for the producers and breeze for covering the bottom mouthpiece lids is fixed in the yard at the gable end nearest the coke yard. The framework is of strong design, built of angles and channels, rigidly braced, and connected to the hoppers over the retort-bench by a gangway fitted with rails for the waggons. The hoist is fitted with a cage, provided with safety gear which comes into operation should any of the ropes break or unduly stretch; automatic gates being arranged at the entrance and exit.

Hydraulic Plant.

The hydraulic plant supplies power for the waggon tipper and hoist, also for operating the bottom mouthpiece lids. It consists of a duplex steam-pumping engine and accumulator. The working hydraulic pressure is 700 lbs. per square inch. The accumulator is fixed outside the engine-house, and has a casing constructed of steel weighted with sand. The cylinder is fixed to a heavy cast-iron base plate, and the casing is guided in a structure which is attached to the wall. The pump is fitted with a valve which is automatically controlled by the accumulator; the pump only working as power is consumed by the plant.

At the conclusion of the ceremony at the gas-works the company adjourned to the Town Hall, where dinner was served. Mr. Councillor Harvey Robinson presided.

The loyal toasts were enthusiastically honoured.

Mr. F. Hampshire (the Chairman of the Horbury District Council) proposed "The Mayor and Corporation of Ossett." He said that he was present as the representative of the closest neighbour of Ossett, and of a Council which was a large consumer of the article produced by the new plant. He referred to the great amount of work which Mr. Robinson had done to bring the installation of the plant to a successful conclusion, and said he felt that the outside public did not really realize and appreciate such valuable work as had been done by Mr. Robinson and his colleagues on the Gas Committee. He believed that in Ossett they had now a system in operation which was a credit to the town. He trusted that the Ossett Corporation would be as painstaking in supplying Horbury with brilliant light as they were in getting an efficient plant, and he hoped that the light which they would receive would lead them on to a firmer and faster friendship all round.

Mr. Stead (the Mayor of Ossett), in responding, said the Corporation of Ossett had in the past landed themselves in difficulties with their municipal undertakings, and similar remarks had been made regarding the present occasion. He, however, was there to say to Mr. Robinson and to Mr. Mottram, their Gas Manager, that the difficulties were not insurmountable. A great deal depended on these gentlemen and on the Council as representing the borough. He had had the pleasure that afternoon of seeing the "golden egg" which he had referred to in a speech the day previously, and their duty was not to neglect anything that was necessary, and not at the present time to go in for anything that was unnecessary.

Alderman Bentley proposed, "The Chairman and Councils of Horbury, Crigglestone, and Shitlington." He said that the Horbury Council had been described in various positions with regard to the Ossett gas undertaking—"partners, sort of partners, and not partners at all." So far as the Council itself was concerned, it was a case of "heads I win, tails you lose." If there was a loss on the gas-works the Horbury Council did not share in it; but if there was a profit, they put their hands in to take a part of it. It was a delightful arrangement for Horbury. They in Ossett thought that the Horbury men were very shrewd people at making a bargain. The Ossett Council had, for the most part, lived on friendly terms with their somewhate cute neighbours at Horbury; and they were hoping that the union of Ossett and Horbury might become closer, and ultimately result in the two authorities being so closely drawn together that they would be merged in one body. Although Crigglestone consumed gas in their houses, they had not had courage yet to light up their streets.

Mr. Hampshire having replied on behalf of the Horbury Council,

Mr. Clark (Shitlington) said that his Council intended lighting their area to the Flockton boundary, as it was not right that they should leave the 300 yards which linked Flockton and Middlestown. In this district 300 men went to work in the mornings without light, all for the sake of the laying of 300 yards of mains. He sincerely hoped that the new gas plant would prove a big success for the Ossett Corporation and the outlying districts, in the direction of keeping prices a little lower than they were at the present time.

Mr. Hobson (Crigglestone) said his Council were the second largest consumers of the Ossett Corporation gas. About six years ago they had their area linked up, and since then they had not had a very great number of complaints so far as the supply of Ossett gas was concerned. The Ossett Corporation supplied gas at Newmillerdam (six miles away), and it reflected credit on the works that they should be able to give such a good supply to a district so far distant from the works.

Mr. Charles Wood (Bradford) proposed "The Chairman and Members of the Ossett Gas Committee." He said that the only reason he could think of for having the honour of proposing the toast set against his name was that perhaps in Bradford they were one of the early users—the pioneers, he thought, or if not the pioneers almost the first users—of vertical retorts in Yorkshire. The Ossett Gas Committee had visited Bradford on one or two occasions to see the vertical installation there; and he had no doubt they had profited by what they had seen. He (Mr. Wood) was rather ashamed of Bradford because, although the installation had been working for about 2½ years, they had never yet had an official opening. At the present time, however, they had a very much larger plant in process of erection; and they hoped to have a very good official opening in connection with it. With a new plant, they had always some little difficulties to contend with; but in Bradford the plant had been running continuously for 2½ years, and they had never to this day regretted having gone in for vertical retorts. He was a firm believer in carbonizing with verticals. At present, the Bradford plant was making considerably over 2 million cubic feet of gas every day, and they were now installing a plant to make 5½ millions. He hoped in the future—it all depended on the duration of the war—to make the whole of the Bradford gas (something like 10 millions per day) in vertical retorts. He had been very much struck by the neatness of the arrangements of the Ossett plant; and he was quite sure that they as a Corporation would never regret having gone in so thoroughly for vertical retorts.

Mr. Robinson, in responding, said the Ossett Corporation were very much indebted to Mr. Wood for the information he gave the Corporation's representatives when they visited Bradford. The Ossett Gas-Works came into the hands of the Corporation in 1901, when the works were purchased by Act of Parliament, and the price settled by arbitration. The foundation of the great success which had attended the Ossett Gas-Works during the past thirteen years was undoubtedly laid by the old Gas Company, who were certainly the pioneers of the gas industry in the district. Speaking generally, when the works were originally taken over, the plant was working at its full capacity, and was producing 84 million cubic feet of gas per year. Of this, 70 millions were sold to 3453 customers. In the last 13 years there had been a remarkably steady and continuous growth in every branch. The works had produced 147¾ million cubic feet of gas, of which 135¼ million feet had been sold to 8635 customers. The works cost (including goodwill) £97,500, and together with other assets and expenses, £114,750. Since the time of the purchase the Corporation had spent, in round figures, £25,000 on the works on capital account—exclusive, of course, of the present extensions. When the works were taken over in 1901, the retorts were hand-charged and direct-fired. The Gas Committee immediately removed the whole of the retort-benches, and rebuilt them with regenerative furnaces at a cost of something like £5000, part of which was paid out of revenue. This was practically all that had been spent upon the works, until (say) a year ago. It then became apparent that something would have to be done. The consumption was going up by leaps and bounds; and at last they reached a point beyond which it was not safe for them to go. Then it became a question whether it would be best to extend the present retort-house at comparatively small cost, and thus perpetuate a laborious and wasteful system of carbonization, or launch-out and spend something like £20,000 or more on an economical and efficient plant. The Council eventually decided—wisely decided, he thought—upon the latter, and appointed a Sub-Committee, who, after exhaustive investigations, came to the conclusion that the intermittent system was the most suitable for the purposes of Ossett and district. He might say that the Committee started out upon their investigations strongly prejudiced against verticals of any make—speaking for himself he was determinedly against them—but they were convinced by what they saw, and by the experience of other works, that vertical retorts were the retorts of the future and that they could be safely adopted for Ossett. He expressed the Gas Committee's thanks to all the gas managers who had allowed them to look round their works during their investigations.

The Chairman proposed "Messrs. Leech, Goodall, and Co." In the course of his remarks, he referred to the good relationship which had existed throughout the erection of the new plant. The war, however, had intervened, and had disarranged and delayed the despatch of material somewhat. But the great cause—and of this he was very proud—was that some thirty men, perhaps more, who had been employed upon the job were now serving with His Majesty's Forces.

Mr. C. A. Goodall responded. He said that in the erection of any plant the contractors were always greatly assisted or deterred by the attitude of the manager of the works concerned. In this case, Mr. Mottram had gone out of his way to help the contractors, and had assisted them largely in being able to carry out the work satisfactorily. He trusted the installation would be one which the Ossett Corporation would never regret, and the success would be such that some time in the future they would repeat the contract. He asked the Chairman to accept a tie pin from the firm as a memento of the occasion.

Mr. Mottram proposed "The Visitors," and in doing so said that at Ossett they had adopted a patent of Mr. Nelson's—the tar off-take—which he believed was the key to the question of carbonization by vertical retorts. A number of those present were, no doubt, in the same difficulty which had confronted the Ossett Corporation—their plants were getting too small, and they would have to enlarge. They were up-against the difficult problem of having to decide what system to adopt. Circumstances varied; but he was quite satisfied that in Ossett they had adopted what would suit their purposes the best. They had done well so far, he could assure those present; but he would not give any figures that night. He believed that theirs was a model plant; and he expected, and was sure, that they would get the good results which they anticipated.

Mr. R. Nelson (Hull) replied. He said that in East Hull they had had their vertical retort installation working for about 1150 days. Three of the settings had been working continuously during this time, with the exception of being let down twice for inspection; and during the whole period there had not been any repairs needed to the settings other than a little renewal. The retorts themselves had never been touched.

The proceedings then terminated.

WORKS TOPICS.

By "Modus Operandi."

The importance of mechanical engineering in gas-works of any but small size is shown in Mr. Leech's report on the proposed re-organization of the works of the Leeds undertaking. From beginning to end, the proposals include the installation of various modern mechanical plant for the economical handling of materials.

Coke Handling by Telphers.

It is seen that for coke-handling Mr. Leech favours telpher plants; for at both the New Wortley and the Meadow Lane works, which in the near future will manufacture the whole of the gas, this type of plant is to be adopted. A few years ago coke conveyors were usually favoured; but lately the advantages of the former system have become recognized. The coke conveyor is more expensive both to instal and to maintain; it is more destructive to the coke; and it is not nearly so accommodating in storing the material at various points in the coke yard. These are very substantial disadvantages; and it is not surprising that telpher plants are growing in popularity. They have much to commend them; and especially is this the case in respect of the gentle manner in which the coke is handled (a most important point), and in the modest cost of upkeep, which, except in a minor degree, is practically limited to the skips that carry the coke. Comparing this with some hundreds of feet of chain, of cross-bars, and floor plates, which have frequently to be renewed in the case of the hot-coke conveyor, one cannot but be impressed with the practical utility of the telpher system. This type of plant has certain minor disadvantages; one being that it is apt to limit the speed with which a "draw" can be completed. It is also rather more expensive in labour; and further, the coke is not so easily quenched as in the case of conveyor plant. But, in the writer's opinion, there is no question that the disadvantages are far outweighed by the advantages. This is one lesson to be learnt from the proposed scheme.

The Mechanical Engineer.

Throughout the report it is seen that the provision of machinery will result in some very material economies. This requirement of modern gas-works (with the necessity for which most will agree) emphasizes the importance of the mechanical engineer in large works. An efficient works manager, to be competent, must be a good mechanical engineer; for one of his principal duties will be to keep a great deal of mechanical plant in effective running order. This point must not overlooked in training the young gas engineer. This is too often the case; but it is bound to be fully recognized sooner or later. Thus, considerable skill in mechanical engineering must be possessed by the modern gas engineer; and this is another lesson to be learnt from the very comprehensive scheme set forth by Mr. Leech.

Concentration of Works.

The shutting-down of the badly situated works is a point to the importance of which the wise administrator is always alive. In the Leeds report it is explained that, owing to the absence of railway sidings at York Street works, it will be more economical to concentrate the entire manufacturing operations at the two larger works. The advantages of such concentration are very obvious; but of recent years the extreme cheapness with which steam-waggons will transport coal and coke in bulk, when proper facilities for speedy loading and unloading have been provided, has in one or two noteworthy cases turned the scale in favour of the continuance of manufacture in a badly-placed works.

It is sometimes the case that the proper distribution of gas and the local sales of coke are much assisted by such a policy, which must always also be greatly influenced by the advantage of using existing plant, and so saving the expenditure of additional capital. The safeguarding of the supply is, too, always influenced by the number of manufacturing stations. Having regard to the possibilities of cheap transport from one works to another, and the distance over which coal can be carried by steam waggon for a few pence per ton, many an otherwise extravagant works could be given a new lease of life.

In any case, no general principle can be laid down; for local circumstances must always be the deciding factor. Even an outsider, having no acquaintance with the Leeds works, cannot but be impressed by the sound reasoning and common sense of the whole scheme of re-organization. To the technical mind, it reads true and convincing; and it needs no prophetic vision to foresee the gratifying results which are bound to follow the development of the scheme.

FIRE CLAY GOODS, AND THEIR USE IN GAS-WORKS.

By Thomas Holgate, F.C.S., M.Inst.C.E.

(*Continued from p.* 537.)

The foregoing considerations all point to the desirability of removing iron from fire-clay in whatever state of oxidation it may exist; and we now proceed to inquire what success is likely to attend efforts directed to its removal. Evidence is now available showing that both Continental and English fire-clays have been successfully purified from iron in large-scale working; but the possibilities of these processes and their limitations will be best understood if prefaced by an inquiry into the magnetic properties of the minerals found in fire-clay. In the case of the Glenboig clay, we appear to have the iron present not as a silicate. But in other fire-clays this relative simplicity may not exist, and so the effect of combination masking magnetic behaviour must be borne in mind.

The possibility of change in this regard during heating must also be noted. For instance, where molten iron pyrites (FeS_2) have come in contact with porcelain, dark brown spots have formed, and microscopical examination of these proved the presence of skeletal groups of magnetite octahedra and needles of sillimanite. Here iron pyrites, non-magnetic, has given rise in contact with a highly refractory silicate of alumina (Al_2SiO_5) to magnetite—the most magnetic mineral known. Again, clay has the property of absorbing iron from dilute solutions of its oxides or salts; and this may be finely distributed and only differentiated with difficulty.

Mr. T. Crook, F.G.S., of the Imperial Institute, to whom I am indebted, has shown how the hand and electro-magnet may be of use in petrography. Taking steel to be the standard with an intensity represented by the number 100,000, he has compiled, from the work of Delesse, a list of magnetic minerals, beginning with magnetite as 64,121, titaniferous magnetite 48,405, ilmenite 5764, pyrrhotite (FeS) 4718, and hæmatite (Fe_2O_3) 2352, all of which exist in clays. The list proceeds next to hypersthene at 687, and ends with oligoclase and tourmaline each at value 4. Broadly, the presence of iron, manganese, cerium, and other paramagnetic elements tends to increase the magnetic power of a mineral; while the presence of silica alumina, lime, water, fluorine, and other diamagnetic constituents tends to diminish it.

The magnetic power of a compound consisting of two paramagnetic elements is less than the sum of the separate magnetic powers of the two elements, and, on the other hand, when water enters into the composition of a mineral, it does not exert its full diamagnetic effect. The contrast between hæmatite (excluding those highly magnetic crystals which contain ferrous oxide, probably due to intergrowths of magnetite) and limonite (which is hydrated ferric oxide) is a good example of the effect of hydration in diminishing the magnetic power of a mineral. Delesse observed that the magnetic power of sulphides diminished very rapidly as the percentage of sulphur increased. Thus pyrrhotite (FeS), with 36·48 per cent. of sulphur, was highly magnetic [see above]; while ordinary pyrites (FeS_2), with 54 per cent. ofsulphur, was practically non-magnetic, for sulphur is a diamagnetic element.

The present writer has made a selection of the constituents of clay embraced in a classification by Dr. C. Doelter. Placing the most magnetic minerals in Class I., he proceeds to those of lower intensity. In the third column is given the maximum distance from the poles at which grains of uniform size were lifted by the magnet, the significance of which will be seen in the description of the machines now employed for the purification of clays.

Magnetic Intensity by Classes.	Example of Minerals in the Class.	Distance of Lift by Magnet. Millimetres.
1	Magnetite	12·0
2	Hæmatite, Ilmenite (*a*)	6·0
3	Siderite (*b*)	5·0
4	Limonite, Lievrite	4·7
7	Tourmaline (*d*)	2·1
9	Pyrite	0·6
10	Rutile (*a*) (TiO_2)	..
11	Muscovite (*c*)	..
12	Dolomite (*b*)	..

(*a*) Titaniferous. (*b*) *See* sideroplesite of the Glenboig mine. (*c*) *See ante*, p. 364, respecting the formation of clay. (*d*) *See* below, *re* clays treated in "Osmose" machine.

A hand horse-shoe magnet is capable of attracting the most magnetical minerals; but an electro-magnet with suitably shaped adjustable pole-pieces is necessary for separating those of less intensity. Here, then, we have a means of discrimination which is particularly well suited to the examination of a brick, crushed into grains, either before it has been used in a retort-setting or after, to ascertain the content of magnetite or of ferric oxide, and applicable also to the ground fire-clay used for the setting of the fire-bricks, tiles, and retorts.

Herr Pebal has called attention to the fact that, when operating on fine crushings, the separation can be made more efficient by keeping the crushed fragments immersed in water during the process. If pyrites (FeS_2) be present, then, after the separation of the magnetic constituents, the grains may be heated in air so as to burn off the sulphur, leaving the iron as an oxide, after which it also can be separated magnetically.

A method of extraction of iron from clays was fully described by Mr. H. H. Thompson in the "Transactions of the English Ceramic Society," Session 1913-14. The apparatus consists primarily of an inclined trough having a series of electro-magnetic bars fixed laterally in the bottom; the magnet windings being housed underneath. Electro-magnets are from two-and-a-half to ten times as efficient as permanent magnets. The edge of each bar is magnetized along the whole of its length and width. The projections are curved like a fan facing the approach of the

liquid slip, which is broken against a number of vertical serrations on the curved faces. The trough is inclined at an angle of 50°, and the liquid flowing down it is throughout in actual contact with magnets—a condition which is necessary owing to the resistance offered by the slip to the passage through it of minute particles of iron. Moreover, minute particles possess only sufficient magnetic permeability to be held by a magnet when actually in contact with it. A magnet which attracted horizontally a 6-inch nail from a distance of 10 inches was able to attract a speck of iron from only 2½ inches.

In the same Society's "Transactions" Mr. W. R. Ormandy, D.Sc., gives an account of the purification, first of Continental, then of British clays, by an electric process, in an "Osmose" machine. The electro-osmotic treatment of clays depends upon the fact that clay substance is electro-negative, the bulk of the impurities (iron and titanium compounds, &c.) electro-positive, and free silica neutral. The machine consists of a semi-circular trough in which is a revolving drum made of conducting metal and acting as anode, and about half-an-inch away, a wire netting cathode brought underneath. Between the drum and the netting the clay suspension runs under the influence of a direct current of 60 to 100 volts. The impurities collect on or under the netting; the clay coming off the top of the drum in the form of a continuous blanket, 4½ feet wide and ¼ inch thick. It is claimed that clays of inferior quality can thus be converted into high-grade clays, and that with clay from the same geological level the finished material is standard and homogeneous. Coloured china clays may be induced to yield paper white clays if previously green or bluish, as the impurity is here due to tourmaline or double silicates containing some iron, and either neutral or electro-positive [see Doelter's classification, *supra*]; but it is more difficult to remove yellow or brown colouring matters, due to the presence of iron phosphate and humic substances.

(*To be concluded.*)

NOTES ON THE VISCOSITY OF GAS-OILS.

By A. V. Hendrickson.

Whether the viscosity of an oil is of any use in determining its value as a lubricant, is a moot point; but the following figures are of interest in that they show the viscosity of several types of gas-oil as used in the manufacture of carburetted water gas.

Viscosity may be expressed in different ways—the two most general being relative or specific viscosity referred to a standard liquid, and in absolute units as dynes per square centimetre. Absolute viscosity is a measure of the tangential force per unit area of either of two horizontal planes at unit of distance apart, one of which is fixed, while the other moves with unit velocity—the space between the planes being filled with the viscous substance.

Relative viscosity is arrived at from the formula—

$$\eta = \eta^1 \frac{d\ t}{d_1\ t_1} \text{ where}$$

t = transpiration time of the oil
d = density of the oil.
η = viscosity of the oil.

η^1, d_1, t_1 having the same meaning referred to the standard liquid. If water be the standard liquid, and its viscosity be taken as 1, then the specific viscosity of the oil is:

$$\frac{d\ t}{d_1\ t_1}$$

From these figures absolute viscosity can be calculated.

After many trials, the viscometer finally adopted was that of Ostwald. Its construction can be seen from the sketch, fig. 1. It has the advantage over any other of being suitable for small quantities of liquid. The instrument is suspended vertically in a water-bath. A definite quantity of liquid is added by a pipette; and after the liquid and water bath have attained the desired temperature (which must be maintained constant throughout the test), the oil is drawn or driven slightly above the mark G, and the time taken by the liquid in flowing from G to H, through the capillary tube C, noted. F is a stirrer, to ensure an equal temperature in the water bath, which is measured by the thermometer. In the tests here quoted, the oil was driven up above the mark G by air-pressure applied at E—obtained by means of a Bunte burette and water vessel.

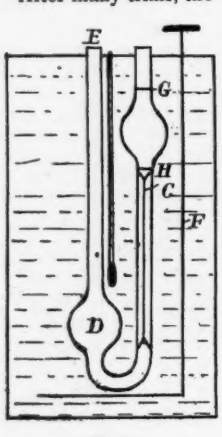


Fig. 1.

The viscometer has the following measurements:—

Volume flowing between G and H. . . .	5·86 cc.
Volume of oil used for filling	7·20 cc.
Length of capillary	45 mm.
Diameter of capillary	0·6 mm.
Mean pressure producing flow	58 mm.

From these dimensions, the velocity of efflux of the liquid from the end of the capillary can be arrived at from the formula.

$$\frac{V}{n\ r^2\ t}, \text{ where}$$

V = volume transpired in cc.
r = radius of capillary in cm.
t = minimum time of flow in seconds.

Then, by calculation, we get:

$$\frac{5{\cdot}86}{3{\cdot}1416 \times 0{\cdot}03^2 \times 104 \text{ seconds.}} = 19{\cdot}93 \text{ cm. per second.}$$

This is well within the limit given by Poisenille, so as to avoid eddying currents in the liquid as it leaves the capillary.

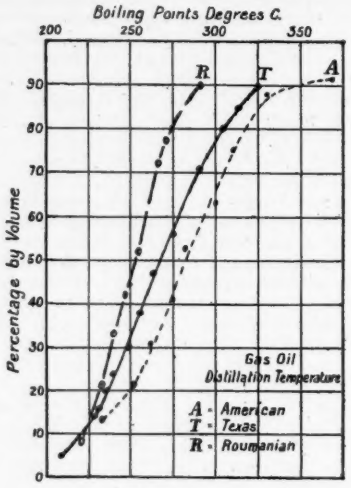


Fig. 2.

The graph, fig. 2, shows the boiling points of three different gas oils; the distillation being from a small flask with a side tube, the bulb of the thermometer being just below the level of the entrance to the latter.

The curves in fig. 3 exhibit the viscosity of these oils compared with water.

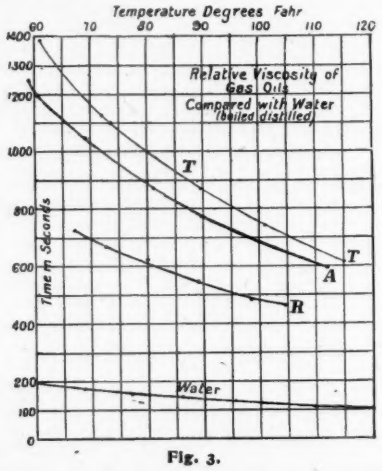


Fig. 3.

From these data, the following figures showing the specific and absolute viscosities have been calculated; the absolute values being calculated by multiplying the specific viscosity of the oil by the absolute viscosity of water (Thorpe and Rodger's figures) at the same temperature.

American.			Roumanian.			Texas.		
Temp. Degs. Fahr.	Viscosity.		Temp. Degs. Fahr.	Viscosity.		Temp. Degs. Fahr.	Viscosity.	
	Specific.	Absolute		Specific.	Absolute.		Specific.	Absolute.
60·5	5·143	·05760	67·0	3·563	·03413	61·0	6·253	·06941
69·0	5·095	·04993	72·5	3·484	·03275	72·0	5·947	·05709
81·0	4·850	·04171	80·0	3·502	·02987	73·5	5·895	·05472
89·5	4·778	·03679	89·0	3·460	·02647	79·0	5·723	·04718
112·0	4·443	·02732	98·5	3·403	·02246	89·5	5·537	·04236
..	..	..	104·5	3·395	·02173	101·0	5·249	·03543
..	..	..	..	..	..	115·0	5·006	·02903

The absolute viscosity of water, as determined by Thorpe and Rodger, is shown in the next table.

0° C. = ·01778	40° C. = ·00653	80° C. = ·00356
10° ,, = ·01302	50° ,, = ·00547	90° ,, = ·00315
20° ,, = ·01015	60° ,, = ·00468	100° ,, = ·00283
30° ,, = ·00798	70° ,, = ·00406	

The values for intermediate temperatures were obtained from a curve plotted from the given figures—see fig. 4.

The difference between the three oils is shown very clearly by plotting the data for specific viscosity.

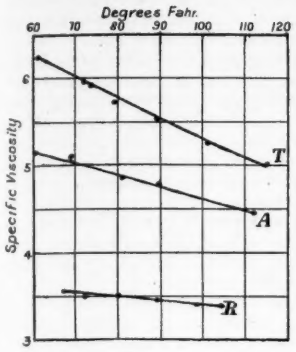


Fig. 4.

A determination of viscosity at one or more temperatures seems a means of helping to decide as to the origin of a particular gas oil. Boiling points may be, and probably are, "arranged;" but it seems probable that a determination of the viscosity would detect this. It should be found useful as indicating whether the delivered oil is up to the contract sample.

The study of viscometry appears therefore of some advantage even in a gas-works laboratory; and possibly the results of its further application may be given at some future date.

PRESSURE REDUCTION AND REGULATION.

At the last Annual Meeting of the Pacific Coast Gas Association, a paper on "Problems of Pressure Reduction and Regulation" was submitted by Mr. A. W. Cash. In the course of it he made the following remarks.

It is known to those who have given the matter any thought that the reduction in pressure of any fluid while flowing is caused by friction alone; and the only way to produce this friction is to force the fluid through some conduit, pipe, or orifice at a velocity high enough to cause the required reduction or loss in pressure—the degree of velocity varying with the specific gravity of the fluid. If we assume that a fluid such as gas is caused to flow from a receptacle or pipe having a high pressure through a small orifice in a thin diaphragm into a receptacle or pipe having a lower pressure, the reduction or loss of pressure will be directly proportional to the velocity through the orifice. If the high pressure remains the same with constant quantity being used from the low-pressure side, the velocity through the orifice will be constant, and there will be a constant reduced pressure. If, however, the volume of gas taken from the reduced pressure side is varied, the velocity through the orifice will vary, with a consequent change in the reduced pressure.

In the installation of automatic reducing and regulating valves, since neither the initial pressure nor the volume of delivery can remain constant under working conditions, it is necessary to provide some form of adjustable or controllable orifice if the reduced pressure is to be kept constant, regardless of the volume of delivery. Again, as friction losses in pressure of fluids flowing through pipes vary directly as the volume and the length of the pipe, it is necessary to provide pipes of sufficient size to transport the maximum required volume without serious loss in pressure. Therefore, in every case where any considerable reduction in pressure is required, the area of orifice necessary to pass the full capacity of the pipe will be many times smaller than that of the pipe required to deal with the volume with the reduced pressure.

As reduction in pressure is caused by friction, and friction is created by causing the fluid to flow at a sufficiently high velocity, it follows that, to create a certain amount of reduction in pressure, the fluid must pass through an orifice sufficiently restricted to create the required velocity. It may therefore be seen that the area of the orifice and the velocity will be the same, whether a proper size of valve is used or one unnecessarily large. Under usual conditions, the valve of proper diameter of seat to accommodate the maximum flow with a small margin to spare will open wide enough to pass the flow in a compact mass carrying with it any foreign substance; but a valve unnecessarily large in diameter, while having exactly the same actual area of opening, must necessarily supply it in a narrower and longer extended form, readily obstructed by foreign substance in the fluid.

By way of illustration, we will assume that it is required to supply a 10-inch line with gas at 8 oz. pressure, reduced from an initial pressure varying from 3 lbs. to 50 lbs.; 50,000 cubic feet of gas per hour being taken from the 10-inch main. A velocity of 15,000 feet of gas per minute would be necessary in the 10-inch main, and to reduce from 3 lbs. to 8 oz. delivery pressure the gas will have to flow past the restricting valve-seat at a velocity of approximately 85,000 feet per minute. So that a single-seat valve having a seat 3 inches diameter and a lift of about 9·64ths of an inch would supply the gas required; and with a higher initial pressure the lift of the disc will be much less. If for the 3-inch diameter seat opening a valve with a 10-inch opening be installed, the lift of the valve-disc would be only about 3·64ths of an inch, which condition would render the valve extremely liable to obstruction and injury from particles of scale, cuttings, grit, or other foreign substances which might be in the pipe or be carried along by the gas.

It is generally well known that the obtainable volume of fluid through a pipe of given size will vary as the density of the fluid. For example, manufactured illuminating gas being 30 to 35 per cent. lighter than air, a pipe will convey 30 to 35 per cent. greater volume of gas than of air, and it will likewise convey a greater volume of air than steam, and of steam than of water. Yet, in a general way, it has been found that the same proportional sizes of pressure-reducing valves apply on pipes for conveying the different fluids, with some modification on account of materials permissible for use with the fluids.

The author gave some illustrations of six pressure-regulators all having a seat opening equal in area to 1-16th of the ¾-inch pipe on which they were to be used; and careful measurements by him, under actual working conditions, on three of these makes showed, he said, that with the initial pressure as low as 3 lbs., and with the full volume of delivery at 3-inch water column, the seat disc had a lift of only one-half its full capacity, or about 1-32nd the area of a ¾-inch pipe. As 200 cubic feet of gas per hour flowing through this pipe would be at a velocity of about 1152 feet per minute, in order for this amount to come through the seat opening of 1-32nd the capacity it must flow at a velocity of about 36,864 feet per minute. With a consumption of 250 cubic feet per hour, the velocity through the regulator seat would be about 44,236 feet per minute; with an initial pressure of 15 lbs., the actual velocity through the seat would be more than 85,000 feet per minute; and with higher initial pressures it would be correspondingly greater. From this it may be seen that with very high initial pressures the diameter of the seat opening must be decreased, or else the lift of the valve-disc would be so slight that it would be quite easily obstructed by foreign substances which could not be kept out by a screen of practical fineness.

In large-size regulators of the double-seat type, and also in the diaphragm and lever construction, even where the seats are of the proper proportion for the amount of reduction to be made, another difficulty is often presented. Naphthalene and substances of a tarry nature coat the inside of the regulator, in the seat openings, and on the seating portion of the valve-disc clog and obstruct the free operation of the moving parts, and cause considerable change in the delivery pressure, or prevent complete closure when no gas is being used—thereby causing a dangerous increase in delivery pressure before the evenly balanced diaphragm structure has enough power to crush the substance lodged or coated on the valve-seats.

The writer's experience, covering more than twenty years, in the design, manufacture, and installation of pressure reducing and regulating valves in various kinds of service, has led to the single-seat valve being regarded as the proper solution of the problem for all kinds of services and all sizes of valves; and while his experience in the design and manufacture of valves for gas service has been only a little more than three years, thus far it has not shown that they require a construction materially different from those used in other lines of service. He is convinced that the most positive and accurate regulating valve in the market to-day is equally well adapted for service on cold water, hot water, steam, air, gas, and oil; requiring only slightly varying proportions of its several operating parts, together with seat materials adapted to the several kinds of service.

Self-Purification of Water.—Dealing with this subject in the "Bulletin of the Belgian Chemical Society" [Nov. 28, 1914], M. Flamand pointed out (according to an abstract in the "Journal of the Society of Chemical Industry") that Blondeau's draining-bricks may be used as a support for the material in a sand filter, and extract the water from the sand by capillarity. They are made of a number of folds of earthenware so moulded that each brick consists of 16 draining-tubes in parallel, of which one half have their openings towards the sand and the other half towards the well. The tubes are flattened so that their filtering surface may be a minimum. Under a charge of 4 or 5 metres of sand and water, the delivery of each brick is about 100 litres (22 gallons) per day. The water leaves the brick slowly, so that only an abundant oozing is seen. Sewage passed through a filter of this kind had all its organic matter oxidized and mineralized.

Large Gas-Power Plant.—The Manchester correspondent of the "Engineer" states that what will be the largest single installation of gas-engines has recently been contracted for by Palmer's Shipbuilding and Iron Company, Limited, at Hebburn-on-Tyne. The Directors have been considering the matter for some time, and have been led to the conclusion that a scheme involving large capital outlay will bring in a very good return, by reason of fuel saved and increased convenience of working in the yards, rolling-mills, blast-furnaces, and works. Blast-furnace gas is available as fuel; and this will be utilized in four gas-blowing-engines and six gas electricity-generating units. Before use, the gas will be carefully freed from dust on the dry cleaning system. The blowing-engines will be of the horizontal double-acting four-cycle type, each having two gas power cylinders in tandem with one air cylinder behind them. These engines are normally rated at 2000 B.H.P. each, but are run at a reduced speed for blowing. The gas-engines will be of the high-speed vertical single-acting type, each unit having twelve cylinders on six cranks, and driving a 1000 K.W. alternator. The blowing-engines supply air to the blast-furnaces, while the electric power generated will be used throughout the works. A large number of steam-boilers will be removed, and great saving in fuel is anticipated.

THE REMOVAL OF CARBON BISULPHIDE FROM COAL GAS.

A Paper by Mr. E. V. Evans, F.I.C., F.C.S.

At a Meeting on Monday of last week of the London Section of the Society of Chemical Industry, Mr. E. V. EVANS, F.I.C., F.C.S., the Chief Chemist to the South Metropolitan Gas Company, read a paper on the "Removal of Carbon Bisulphide from Coal Gas"—a subject with which, it will be remembered, Mr. Charles Carpenter, D.Sc., M.Inst.C.E. (the Chairman of the Company), dealt in a lecture he delivered before the Institution of Gas Engineers at Liverpool in June, and also twelve months earlier in a paper read before the Société Technique du Gaz en France.

Mr. Evans began by pointing out that the carbon bisulphide remaining in the gas after the removal of sulphuretted hydrogen represents only about 0·02 per cent. by volume; and in view of the large quantities of gas to be dealt with in the case of a modern London works, the extraction of this impurity should, in consequence of its state of extreme dilution, be effected by a chemical reaction of high velocity. Laboratory investigation was first of all, therefore, concerned with ascertaining the relative intensities of known reactions of carbon bisulphide entailing the use of reagents suitable for large-scale application. These were classified under three heads—*i.e.*, extraction by alkalies or alkaline earths, in presence of sulphuretted hydrogen; interaction of carbon bisulphide and certain amido compounds (like aniline), with or without the use of catalytic agents; and decomposition by heat, with or without catalysts. No examination was made of the "Athion" process, which is of recent origin. As to these investigations, an unsuccessful endeavour was made to place the lime process on a more practical basis by rendering possible the regeneration of the spent material *in situ*. But the scheme only proved satisfactory when making use of pure reagents, and failed altogether when applied to the coal-gas mixture. Other objections were that the reaction involved in the extraction of carbon bisulphide by lime is not of high chemical velocity, and the enormous loss of sulphuretted hydrogen involved in the process as generally adopted. Coming to the second method, it was found that the cost of preventing the loss of the amido compounds, by further washing the gas with weak acids or special oils, and of subsequently regenerating the reagent, would be prohibitive.

This brought the author to the third process—the decomposition of carbon bisulphide by heat, to which in 1908 the investigation was entirely directed—preliminary laboratory work having led to the conclusion that of all known reactions this possessed the greatest possibilities of technical application. The use of various metals as catalysts was tried; and of these iron was found to be the most active, compatible with low original cost. It was found, with the same catalyst, that a low temperature and large surface of contact, and a high temperature and smaller contact-surface, were both effective in securing decomposition of carbon bisulphide. However, to reduce the size of plant as far as possible, it appeared necessary to adopt the highest suitable temperature; the conditions being that the illuminating and the calorific values of the gas should not be altered, and that iron pipes and containers for the catalyst could be conveniently employed. It was proved that, operating at temperatures between 450° and 500° C., the intrinsic quality of the gas was not impaired; and wrought-iron strips were found to withstand successfully a temperature of 450° C., to which they were for some weeks subjected by waste furnace gas surrounding them. Continuous laboratory experiments were then made at a temperature not exceeding this; gas being purified at the rate of 10 cubic feet per hour, with iron turnings as the catalyst. From 75 to 80 per cent. of the sulphur in the gas could thus be removed. Acting upon the experience so gained, a cast-iron retort capable of dealing with 50,000 cubic feet of gas per hour was erected at one of the Company's works; but the cooling effect of this big volume of gas upon the catalyst was such that, even maintaining the outside of the retort at a low red heat, there was practically no reduction of sulphur compounds. In explanation of this fact, the author pointed out that there is a liability in such transfers of laboratory conditions to large-scale work, in the case of reactions involving considerable expenditure of heat, to overlook the fact that generally the laboratory furnace is out of all proportion to what may be economically employed on the large scale. Aëration, too, was found to be unmanageable in this plant. Not only was the catalytic material fused, but a hole was made in the retort under the chemical action of revivification.

These being the conditions, it was decided to give up the idea of employing a metal catalyst, as such; and it was proposed to impregnate some porous body with the catalyst, so that during aëration the particles undergoing change would be divided and intense local chemical action would be prevented. The surface of contact required with iron oxide deposited on a porous nucleus was so great that search had to be made for a more active catalyst. The conditions kept in mind were that it should require the lowest possible temperature for the reaction, that it should remain active a long time, that aëration should be easy, and that the initial cost should not be too heavy. The most active was found to be highly porous fire-clay impregnated with nickel reduced from the chloride. Though there was a tendency to decomposition of unsaturated hydrocarbons in the gas, even at 600° C. the quantity decomposed was insufficient to result in a definite reduction in quality. Greater difficulty was presented by the deposition of carbon on the catalyst, to obviate which the reaction had to be produced at the minimum working temperature.

The determination of the following points resulted in the design of a system of pipes in which the reaction was successfully reproduced: (*a*) The degree of preheating the gas before contact with the catalyst. Only by means of raising the temperature of the gas to that of the reaction before contact with the catalyst was the full value of the latter realized. (*b*) The surface area of the catalytic material exposed per unit volume of gas passed. (*c*) The porosity, specific heat, and thermal conductivity of the porous carrier. (*d*) The volume of free space to be allowed between the contact surfaces. (*e*) The surface area of the reaction and preheating vessels exposed to the heat of the furnace, and the thickness and thermal conductivity of the material.

This system of tubes, the author said, consisted of one 6-inch reaction tube (this containing the catalyst), and sufficient 2-inch diameter empty preheating tubes to raise the untreated gas to within 50° C. of the reaction temperature. Upon this basis, two large-scale plants were designed and erected—one in 1911 to deal with 2 million cubic feet of gas per day, and the other in 1913 for 10 million feet. In constant working for nearly two years, the last-named installation has resulted in an average reduction of 80 per cent. of the sulphur compounds of the gas treated in it. To show the characteristics of the gas before and after treatment, Mr. Evans referred to the subjoined table, which was contained in Mr. Carpenter's lecture before the Institution of Gas Engineers.

—	Before Treatment.	After Treatment.
Illuminating power . . . . . candles	14·7	14·7
Calorific power . . . . . gross B.Th. U.	590	594·4
Naphthalene . . grains per 100 cub. ft.	5·54	4·71
Sulphur . . . . . " " " " "	35·07	7·82
Hydrocyanic acid . . " " " " "	22·19	18·75
Analysis—		
CO_2 per cent. by volume	1·44	1·45
C_nH_m	3·55	3·63
O_2	0·33	0·06
CO	8·16	8·03
CH_4	26·85	27·26
H_2	54·19	54·25
N_2 (by difference).	5·48	5·32

Continuing, the author remarked that ammonia was to be detected in gas leaving the plant; and though the quantity involved was too small to represent a financial asset, it was useful in maintaining strongly alkaline the iron oxide employed to remove the sulphuretted hydrogen formed. The process removed practically the whole of the oxygen contained in the gas. The volume of the gas before and after treatment, however, was the same. There was a tendency to a slight increase in the methane content of the gas. A question which had been raised as to the possibility of forming nickel carbonyl had, the author said, been carefully considered. The treated gas had been subjected to a number of qualitative tests; but all attempts to detect nickel had failed. Even with the working temperature reduced to 250° C., nickel carbonyl was not produced; but as a precaution no contact of the gas and the catalyst was allowed at any temperature below 300° C.

Allusion was then made to the improved 15 million cubic feet per day plant (divided into five 3 million feet units) erected at East Greenwich. In this plant, the reduction of initial cost was aimed at; and the 2-inch preheating pipes were successfully replaced by tubular heat-interchangers erected outside the furnace setting. In these, the treated gas flows in the opposite direction to that needing treatment. The operation of revivifying the material of any one unit was then explained. The chamber temperature is lowered, and air at a definite rate pumped through the reaction tubes. About a week is occupied in the process; and during the first four days of this period the whole of the oxygen of the air is utilized and replaced by carbon dioxide. The temperature of the chamber is raised to 430° C. when oxygen appears in the effluent gas; and this is maintained until carbon dioxide is no longer evolved. The activity of the catalyst is maintained for some 30 to 35 days, at the end of which time there is a gradual decrease in the efficiency of the reaction. The process of aëration, however, immediately restores the original activity; and no signs of deterioration are shown by the catalytic material after having been in operation for two years.

In conclusion, Mr. Evans acknowledged the continuous advice and encouragement received by him from Mr. Carpenter, but for whose guidance, he said, the investigation could not possibly have attained a successful issue.

DISCUSSION.

The CHAIRMAN said the section was exceedingly thankful to Mr. Evans for bringing the matter of the destruction of carbon bisulphide to completion. It was another triumph in a matter which he himself mentioned recently. The so-called catalytic action of nickel, the transferring of hydrogen, and the adding of it to other things, was the most wonderful thing that had been

discovered the past quarter of a century. He was not sure he understood how the nickel worked in this particular case.

Mr. EVANS said it was nickel chloride put on to porous fire-clay, and it reduced to metallic nickel by decomposition.

The CHAIRMAN asked if it were specially reduced beforehand or not.

Mr. EVANS: It was specially reduced by hydrogen beforehand.

Dr. HAROLD G. COLMAN expressed his hearty congratulations to Mr. Evans and to Mr. Carpenter on the results of their work for the removal of the objectionable carbon bisulphide from coal gas; and he and others present could give these congratulations the more feelingly and heartily, as they had had experience of the great difficulties in the way, and had also attempted to devise a satisfactory process, but without success. Those who had had an opportunity of seeing the large-scale plant at work at the South Metropolitan Gas Company's works would greatly admire the manner in which the technical side of the process had also been carried out. That evening they were, however, considering more the chemical side of the process; and one of the most interesting points in this respect was that nickel could be successfully employed as a catalyst without becoming "poisoned." This would not have been predicted *à priori;* for in the attempts to effect the production of methane commercially from carbon monoxide and hydrogen, according to Sabatier's reaction—by heating them to from 250° to 300° C. in contact with nickel as a catalyst—the small quantities of sulphur present in technical water-gas soon brought the reaction to an end, owing to the "poisoning" of the nickel. Mr. Evans has shown that, in spite of this, if the temperature was raised to about 450° C., the nickel was capable of effecting the removal of the sulphur from coal gas, without any "poisoning" effect being observable after two years. The great difficulty in the way of devising a suitable process for the removal of carbon bisulphide from coal gas had been that of cost. Many chemical methods were available for removing the impurity; but the costs had proved prohibitive. He himself had been very pleased about twenty years ago, after the publication by Cross and Bevan of their "Viscose" process, to find that alkalized cellulose would completely absorb the carbon bisulphide from gas; and the method looked hopeful. But it was found that for this absorption complete removal of the carbonic acid from the gas was necessary, which would make the process too costly; and the work was therefore discontinued. This process was now again being tried in Germany, under the name of the "Athion" process. A further interesting point was that Mr. Evans had now satisfactorily settled the point as to whether the conversion of the carbon bisulphide into sulphuretted hydrogen by heat was due to its interaction with hydrogen or with steam, as to which there had been some difference of opinion, and had shown that the active agent was the hydrogen. It was shown that the process had no material effect on the illuminating or calorific power of the gas. But the analyses indicated that a slight increase resulted in the methane; and it would be interesting to know whether this was due to a synthesis of the latter from carbon monoxide and hydrogen, or whether possibly the increase was really ethane formed from the ethylene and hydrogen in the presence of the nickel. He asked if Mr. Evans could give any further information as to the form in which the small quantities of sulphur left in the gas after treatment by the process were present. Probably this was there chiefly as thiophene, in which case there would be very great difficulty in its removal, as, owing to the great physical and chemical similarity of thiophene and benzene, it would be a hard matter to remove the former without also affecting the benzene, with considerable effect on the illuminating and calorific power of the gas. Possibly, however, some of the sulphur was in the form of sulphides, such as methyl or ethyl sulphide.

Mr. W. E. OAKDEN asked if the author could say the difference in percentage of the decomposition as made by the presence of the catalyst and without the catalyst. He was not sure, from what had been said about the plant, whether the process had been applied to the purification of ordinary coal gas or only to producer gas. With regard to the secondary reaction, what was the proportion of it to the sulphuretted hydrogen which was decomposed into sulphur and hydrogen?

Dr. RUDOLF LESSING said he had one question to ask; but before doing so he would like to congratulate the author on the excellent way in which he had carried out the investigations upon which this very interesting process was based. At a time when people were discussing ways and means for improving the methods of chemical industry, it was really an example of how work of this kind should be done. Mr. Evans, in close co-operation with his engineering colleagues, had elaborated a plant in a way, and on a scale, which had only been possible by the encouraging support of his powerful Company, which practically gave them *carte blanche*—first during the research stage and then in the trials on the large scale. Considering the many failures which the perfection of such a problem meant, the time spent on it from the first laboratory experiment to the running of a 15 million cubic feet plant must have been quite a record one. In regard to his question. There must be by now some experience available with reference to the proportion of free carbon produced and deposited on the nickel (and subsequently burnt off in the form of carbon dioxide) to the sulphuretted hydrogen liberated —in other words, to the carbon contained in the carbon bisulphide before decomposition. It would be very interesting to establish this carbon balance and compare it with that asked for by one of the equations in the paper. It could possibly be done by ascertaining the total amount of carbon dioxide made during the aëration period, and balancing this with the sulphur deposited in the final purifier. If the carbon found was lower than the equivalent of the carbon bisulphide, it would be indicative of some hydrogenation taking place; if higher, it would indicate de-hydrogenating reactions.

Mr. F. NAPIER SUTTON also congratulated Mr. Evans upon the patience and thoroughness he had shown in bringing the process to a successful issue. Those who had seen the process at work must have been struck by the wonderful practicability and real beauty of it—both mechanically and chemically. He had not yet seen the actual details of the East Greenwich plant; but he saw the Old Kent Road installation about a year ago, and it was very interesting. The difference between this reaction for the removal of carbon bisulphide and the old lime process was simply marvellous. Mr. Evans had not said to what extent the gas was purified by the process; but, as a matter of fact, he believed that only about 8 grains of sulphur remained in the gas per 100 cubic feet, whereas the majority of the coal gas passed into the mains contained about 30 or 40 grains. Therefore it was obvious that this investigation had resulted in a gas far purer than had been known before. It became a sort of standard gas which, he took it, Parliament would in time practically force upon every company. It certainly was an enormous step forward to produce a gas so free from sulphur, because the destructive effect of sulphur upon metal and leather work in private houses was well known. Nobody could now take exception to the combustion of the gas supplied by the South Metropolitan Gas Company, who were to be heartily congratulated.

Dr. BLOXAM said it was curious how unfortunate was the most fortunate of things. Everybody had been congratulating Mr. Evans; but in the past he had been picturing cartloads of indigo leaving the South Metropolitan Gas-Works. Now that Mr. Evans had perfected a most beautiful process for getting rid of the carbon bisulphide, was it likely that he would ever turn his attention to overcoming the difficulties with the amido-compounds in the way of the manufacture of indigo? He was afraid he would never see this indigo.

Mr. W. J. A. BUTTERFIELD added his congratulations to the author. This investigation was, he said, an admirable instance of the successful co-operation of the chemist with the engineer. The chemical process, except for the use of this particular catalyst, was, as had been pointed out, not novel in principle; but the earlier attempt to apply it on a large experimental scale over 30 years ago failed completely because (he thought he might say) the engineers concerned in its development lost heart, when they found that the first plant did not work properly. The author, however, was to be congratulated on his great patience, and upon having engineers and a company such as the South Metropolitan Gas Company to back him during his long work. Mr. Napier Sutton had referred to the possibility of purification of this kind being imposed upon all the gas undertakings of the country. Perhaps it was worth while recalling the fact that this process originated after the restrictions in regard to the removal of sulphur compounds had been withdrawn so far as the London gas companies were concerned. The removal of sulphur was now done of their own initiative. Mr. Carpenter and his co-Directors had thought it desirable that the sulphur in the form of bisulphide of carbon should be removed from the gas. For many years they had been compelled to remove the greater part of it by a tedious process; and then they obtained the sanction of Parliament to be free from any restrictive laws whatever. Thereupon, without any compulsion, they set about producing gas of a higher degree of purity than they had hitherto provided, by an entirely novel process. On this account, he was rather averse to any attempt to exercise compulsion upon other companies. He believed the thing would right itself now that Mr. Evans had developed his process; and that gas companies generally would, in their own interests, supply a gas as pure as the South Metropolitan Gas Company were now supplying. He had had other opportunities of asking all the questions he desired about the process, and the only thing he would say now was with regard to the residual sulphur left in the gas purified by this process. One speaker had thought this mostly thiophene. If this were so, the washing process for the removal of bisulphide of carbon—washing with alcohol—should remove the thiophene. This washing process had been tried in Sweden, and was to have been tried at a works in this country a short time ago, and he would be much interested in the results of the trial—*i.e.*, to see if the sulphur went down from the 7 or 8 grains per 100 cubic feet left by Mr. Evans's plant to practically *nil*. He was also much interested to hear Dr. Colman say that he discovered the Athion process twenty years ago. He (the speaker) was not aware of this when he saw the process at work two years ago in Heidelberg, The size of the vessels for the work being done there, however, had convinced him that the process would be impracticable on a very large scale. This process, and, in fact, all other processes, except the author's and the alcohol-washing process, required the prior removal of carbonic acid from the gas, and were therefore out of the question as competitors with the Evans process.

A MEMBER asked if the non-provision of lagging on one of the heat interchangers was due to the fact that they were too small. Was it because the gas left the apparatus too hot for the next process, and therefore the interchangers were not large enough? Had Mr. Evans the coefficient to find the heat transfer

on these interchanges, because it was an interesting process—the heat interchange between gas and gas? It would be interesting to know it.

Mr. EVANS, in reply to Dr. Colman—as to the constitution of the sulphur compounds remaining after the process—said they consisted to the extent of about 60 per cent. of thiophene. He (the speaker) had condensed the remaining sulphur compounds by liquid air; but they had evaded classification. As to processes that would simultaneously arrest thiophene and benzene, so keen were his Directors to supply a pure gas that consideration had been given to extracting both thiophene and benzene, and of returning the latter to the gas. One speaker had asked whether he knew the extent of the decomposition with and without the catalyst. This question could be indirectly answered by stating that the function of the catalyst was to reduce the temperature of the reaction, and he had curves plotted to show the efficiency of various catalysts. A contact-material alone would effect exactly the same reduction of the sulphur compounds, but at a temperature of from 60° to 100° higher, which was quite dangerous for the iron parts of the plant. Moreover, contact-material often depended upon porosity for its effect; and as this became rapidly destroyed by the deposition of carbon it could not conveniently be used. In reply to Mr. Oakden's question, as to the synthesis of carbon oxysulphide, he (Mr. Evans) said the quantity would be practically immeasurable if the sulphuretted hydrogen in the gas was below 100 grains per 100 cubic feet. Dr. Lessing's question, as to the relation between the amount of carbon dioxide and the amount of sulphur decomposed, was a potent one. It could only be cleared up in the laboratory with the purest of chemicals. Nevertheless, after each aëration it was known how much carbon was burned-off in the plant. If one calculated-back to the amount of work done, it would be found that this was about double the amount of carbon represented by the bisulphide of carbon decomposed—the excess originating from certain unsaturated hydrocarbons of the gas. As he had pointed out in the paper, it was not so much the alteration of illuminating or heating hydrocarbons that was feared in the deposition of carbon, because this was quite immeasurable by existing standards; but it was the deposition of carbon on the catalyst that should be prevented, because this decreased its activity and necessitated more frequent aëration. For this reason the catalyst requiring the minimum working temperature was chosen. Using Northumberland or Durham coal, the average was usually 38 grains of sulphur per 100 cubic feet; and this was reduced to about 8 grains—a reduction of 80 per cent. He also had grieved, with Mr. Bloxam, and in the same room, over the loss of synthetic indigo as a gas-works bye-product. He had spent much time on the Sandmeyer reaction; and it was going quite well. But owing to the loss of the volatile amido compounds, and the fact that a small loss represented a large expenditure, the scheme was abandoned. Mr. Butterfield's remarks, as to previous workers, were quite true. The development of this laboratory reaction to the large scale had been attempted by many chemists and engineers, who had failed, owing probably to the disadvantage of not being sufficiently encouraged.

A hearty vote of thanks was accorded Mr. Evans at the conclusion of the discussion.

LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.

A Meeting of this Association was held in the Westminster Technical Institute, Vincent Square, S.W., on Friday evening—under the presidency of Mr. J. Hewett—to hear a paper read by Mr. T. F. C. Potterton, on "Gas-Heated Hot-Water Apparatus." The circumstances which at present militate against large gatherings at meetings of this character, of course, affected the attendance of members; and, in addition, to put it mildly, the weather was such as to disincline one to "turn out" again after the ordinary day's work was done. However, in spite of a somewhat small audience (which, at the same time, was not unsatisfactory when the drawbacks referred to are considered), Mr. Potterton was able to leave the meeting with the feeling that for any trouble to which he had been put he had been amply repaid. And this is saying a good deal; for he was, while reading the paper, obviously suffering from the effects of a somewhat severe accident to his right hand. He was determined not to disappoint the Association in regard to his promise to read the paper; and those present did not disappoint him in the matter of the interest shown in it.

Notice of the paper, and of the long discussion to which it gave rise, is unavoidably held over this week; but it may be said here that the author, apart from reference to two special forms of domestic supply apparatus, dealt with the subject of warming, and gave the members the benefit of a large amount of data collected by him in connection with ordinary and irregular systems. He pointed out that many instances occur in which, mainly owing to easy regulation, gas water-heaters can be applied with advantage to warming with radiators to meet special cases, even though the running cost does not bear favourable comparison with that of coke or other forms of solid fuel occurring in hot-water supply work. In the remarks, and numerous questions, which followed the paper, the speakers showed themselves fully alive to the importance of the hot-water question as an aid to the distribution departments of gas undertakings.

LIMITS OF INFLAMMABILITY OF MIXTURES OF METHANE AND AIR.

In the "Journal of the Chemical Society" for November, Messrs. M. J. Burgess and R. V. Wheeler discuss in three papers the *pros* and *cons* of the inflammability of methane-air mixtures.

They point out that Messrs. Coward and Brinsley regard inflammability as a specific property of any given gaseous mixture under definite conditions of temperature and pressure—independent of the shape and size of the vessel containing it, and independent also of the nature of the means used for ignition in the first place. In view of this definition, they suggest that the true criterion of a "limit mixture" must be regarded as that in which flame can be indefinitely propagated upwards. The limits of inflammability, however, vary greatly with the direction in which the flame travels. In the case of the ignition of fire damp in mines, a local accumulation may become ignited, and in the absence of an explosive mixture the flame may travel in a horizontal direction for some considerable distance—finally perhaps igniting a richer mixture, and so causing an explosion.

The following figures show the lower and higher limits of inflammability according to the manner in which ignition is effected:

	Methane per Cent.		
	Lower Limit.		Higher Limit.
Central ignition in large globe	5·6	..	14·8
Vertical tube closed at both ends—			
Ignition at bottom . .	Not less than 5·4	..	Not more than 14·8
Ignition at top . . .	6·0	..	13·4
Horizontal tube closed at both ends—			
Ignition at one end . .	5·4 flame travels only along top of tube 5·6 methane all burnt	..	14·3

The manner in which the flame travels in the different mixtures is by no means the same. The flame travelling horizontally in a 5·4 per cent. methane-air mixture occupies only the upper half of the tube; the front of the flame being more or less pointed. The faster the speed of the flame, the blunter its front. Whether a flame can travel indefinitely, according to Coward and Brinsley's definition, is beyond experimental confirmation; but it is pointed out that, with a 5·4 per cent. methane mixture, the distance of travel in a vertical tube reaches 2 metres in a tube 2 metres long. With a 5·35 per cent. mixture the flame travel was only 50 cm. In the case of a flame travelling horizontally in a 5·4 per cent. mixture, and occupying only the upper portion of the tube, the residual gases still contain 3·25 per cent. of methane.

Presuming the case of a large room filled with such a mixture and a light applied at some point near the floor, a column of flame would travel upwards from the point of ignition to the roof and spread along the upper portion only of the room. In this connection, it is mentioned that when a very slow current of air, containing between 4 and 5 per cent. of methane, passes over a small flame, the flame-cap that forms may become detached and float along with the current. Similarly if a slow current of air containing 3 or 4 per cent. of coal gas is allowed to ascend a vertical tube, and a succession of electric sparks is passed at the bottom, small caps of flame can be caused to travel from end to end of the tube—only a fraction of the mixture being burnt.

If a 5 per cent. mixture of methane and air contained in a 4-litre globe is strongly agitated and then ignited centrally, the flame travels rapidly throughout the mixture, and all the methane is burnt, as is also the case with a flame travelling downwards in a 6 per cent. mixture, and in a 5·6 per cent. mixture centrally ignited in a large globe. For this reason, therefore, propagation throughout a globe certainly commends itself for comparative measurements.

A "limit mixture" must be such that a given volume must, under the condition of its combustion, evolve just sufficient heat to raise an equal volume to its ignition temperature. Therefore, provided that the amount of energy imparted by the initial source is small (as a spark) so that no appreciable impetus to the propagation of flame occurs near the source of ignition, the flame should travel throughout a true limit-mixture at a uniform speed. This uniform speed has been experimentally proved to be the same in all "limit mixtures" comprising the same constituent gases.

The figures given below show a series of determinations of the amounts of methane required to form limit mixtures, with various "atmospheres."

Atmosphere.			Methane Per Cent.		
Oxygen.		Nitrogen.	Lower Limit.		Higher Limit.
20·90	..	79·10 (air)	5·60	..	14·82
19·22	..	80·78	—	..	12·93
18·30	..	81·70	—	..	11·91
17·00	..	83·00	5·80	..	10·55
15·82	..	84·18	5·83	..	8·96
14·86	..	85·14	6·15	..	8·36
13·90	..	86·10	6·35	..	7·26
13·45	..	86·55	6·50	..	6·70
13·25	..	86·75	No mixture capable of propagating flame.		

GAS-HEATED HOT-WATER SUPPLIES.

By W. B. Cobb, of Birmingham.

[A Paper read before the Midland Junior Gas Association, Dec. 12.]

Domestic hot-water heating has been the subject of many papers similar to this; yet I venture to think there are many details still imperfectly understood. The practice of hot-water heating by means of pipes is of great antiquity. The method of heating water by passing it through a coil of pipes inserted in a fire was known and practised before the Christian Era. The origin of the invention of employing hot water for diffusing artificial heat appears to be lost; but an apparatus for heating a greenhouse from a kitchen fire, in England, can be traced back to the year 1830. Since then, however, great progress has been made, from the large brick-built dusty boiler chambers to the present neat sectional gas-boilers.

Tank System of Water Heating.

We will now consider the methods of heating water by gaseous fuel for domestic purposes—taking the tank system first. This, as originally installed, consisted of two open cisterns, fixed side by side—generally in the top part of the house, often above the ceiling, and next to the roof—two circulating pipes being taken from the cistern for storing the hot water to the boiler; one of these pipes being used at the same time to supply the different hot-water draw-off taps. This crude arrangement was very soon superseded by that shown in Diagram A, where one of the open cisterns is replaced by a closed tank; thus making it possible to

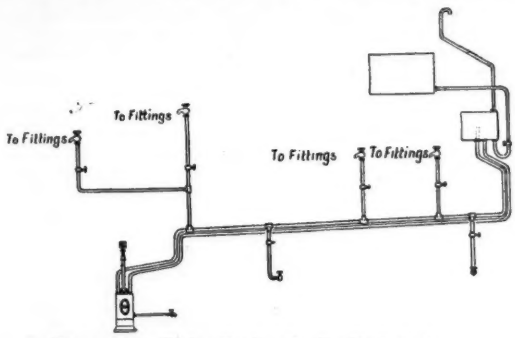


Diagram A.—Water Heating by the Tank System.

fix the hot storage tank in a more convenient place. The hot-water tap supplies are taken, as before, from the flow-pipe, which is carried up to nearly the top of the storage tank. The drawing of hot water from the flow pipe, between the boiler and the tank, as shown in Diagram A, is a bad feature, inasmuch as the tank could be drained empty if the water supply failed, or if the feed pipe was frozen up or became choked from any cause.

The chief advantages of this system are that it is cheap to instal, and, secondly, that small quantities of hot water may be drawn soon after the apparatus is lighted.

The Cylinder System.

Diagram B shows the cylinder system. This I consider to be by far the most satisfactory for the average installation. Therefore, I propose to deal more in detail with this system. Let us take the boiler first. This must be fixed on the same level as, or below, the storage chamber, and as near as possible to the storage chamber—thus doing away with any long lengths of primary circulation pipes (marked primary flow pipe and primary return in the diagram). When long, these circulation pipes lower the efficiency of the apparatus tremendously; and where long lengths cannot be avoided, they must be covered with non-conducting material to prevent the radiation of heat from their surface. Also long circulation pipes offer frictional resistance to the circulation of water between the boiler and the storage chamber.

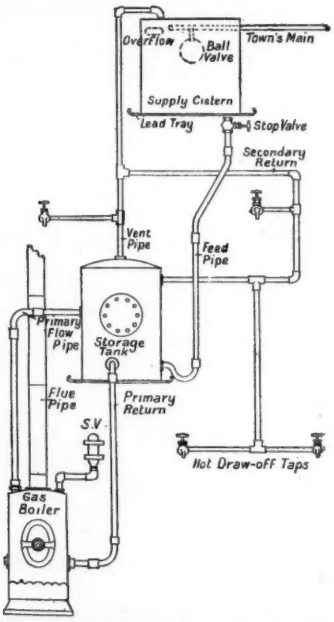


Diagram B.—Cylinder System of Domestic Hot-Water Supply.

A dead-weight safety-valve should be attached to the boiler by an independent pipe about 1 inch in diameter. When these valves are fixed on the circulation pipes, they often get deranged by concussion, when taps are closed suddenly. The boiler must also be provided with a cleansing lid and an emptying tap.

The next item to notice is the feed-pipe. It is a most important part of any system of hot-water supply. It is taken direct from the cold-water supply cistern to the bottom of the hot-water storage chamber, and should discharge horizontally at the base of the storage chamber. On no account must this pipe be used for any other supply. Consider for a moment what would happen if it were. Assume the stop-valve in Diagram C to be turned off, or the pipe to be frozen or choked. Now, by opening the cold-water tap which the additional branch supplies, the whole of the apparatus would be syphoned empty to the level of the tap. The fact of the connection being made above the top of the storage chamber would not alter the result. Therefore, insist that this pipe must be used only for supplying cold water to the hot-water apparatus.

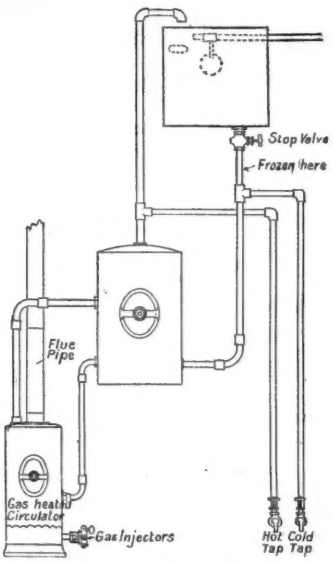


Diagram C.—Faulty System, Showing how the Apparatus may be Emptied by the Cold-Water Tap.

The dip shown at the bottom of the feed pipe is to prevent hot water from circulating from the storage chamber to the supply cistern. This feed pipe must be provided with a good form of screw-down valve, fixed in an accessible position; so that it can be readily turned off in case of repairs. The size of this pipe is governed by the position and number of drawn-off taps.

Exhaust or Vent Pipe in Diagram B.

This pipe is taken from the top of the hot-water storage chamber, in as straight a course as possible, to well above the supply cistern, and left with an open end to discharge either through the roof or over the supply cistern. From this vent pipe are taken all the hot-water supplies to the various fittings. Where there are long lengths of pipe required, it is advisable to make a secondary circulation to the fittings and back into the top part of the storage chamber—shown as secondary return in Diagram B. The advantage of this is that hot water is drawn immediately the hot tap is opened. Another advantage is that the metal of which the supply pipe is composed is kept at a more uniform temperature. This is an important factor where lead pipes are used, owing to lead not being an elastic body. Any expansion and contraction that take place due to fluctuations of temperature cause it to become brittle and porous.

This secondary circulation possesses the disadvantage of constantly radiating heat from the surface of the pipes, thereby increasing the gas consumption. This difficulty may be largely overcome by fixing in the secondary circulation a valve, which could be turned off at night or any period of the day when hot water was not being drawn. Of course, it would have to be the duty of someone to attend to this valve. All hot-water draw-offs must be taken from the secondary circulations.

Here I must draw attention to a difficulty which constantly arises with this secondary return pipe. Architects, builders, and clients constantly want to have the storage chamber fixed in

the bath room, so as to form a heating source for the linen cupboard. It is easy to see that with this storage chamber fixed in the bath room a difficulty will be found in cases where fittings are below the storage chamber, to get a secondary circulation back to the top of the storage chamber. However, I always try to have the storage below; a secondary circulation can then easily be obtained. Primary circulations are shortened, and, in addition, the warming of the linen cupboard can be efficiently performed by means of a coil of pipes fixed below the shelves, and connected with the vent pipe and the secondary return.

Cold Water Supply Cistern.

This must be fixed well above the highest draw-off tap in a well-lighted and ventilated position. It should be easily accessible, be provided with a dust-proof cover and a good sized overflow pipe discharging into the open air. It is a good plan to have fixed under both the hot storage chamber and the cold supply cistern a lead safe, provided with a waste pipe discharging into the open air. Then any leakage or condensation that takes place will not damage the ceilings, walls, &c.

Upon the height of this cold supply cistern will depend the pressure to which the apparatus is subjected. For instance, if the surface of the water in the cistern is 25 feet above the boiler, then the pressure per square inch on the boiler would be 25 times 0·434, equals 10·85 lbs., or a total pressure of 7260 lbs. on a small sized copper circulating boiler suitable for heating about 30 gallons of water. If this pressure were constant, there would be no need to provide a boiler and pipes stronger than sufficient to withstand it; but it is not, for each time a tap is opened and water drawn from the apparatus and the tap closed again, a concussive effect is produced in the water which is transmitted throughout the system, and in doing so momentarily increases the pressure very considerably. I think I have said sufficient to show that the position of the cold-water supply cistern must be carefully selected, and not fixed in any out-of-the-way corner, as it has been so often in the past.

The cylinder system provides a constant reserve of water for the boiler, which cannot be drawn off at any of the fittings. The heated water from the boiler rises through the flow pipe to the storage chamber, and the cold water from the bottom of the storage chamber flows to the boiler by the return pipe; thus a continuous circulation of water is maintained.

Cylinder Tank System.

The cylinder tank system, as will be seen from Diagram D, is simply an extension of the cylinder system; a small tank being introduced at the head of the secondary flow and return pipes. Sometimes a separate return pipe is taken from the hot tank, but

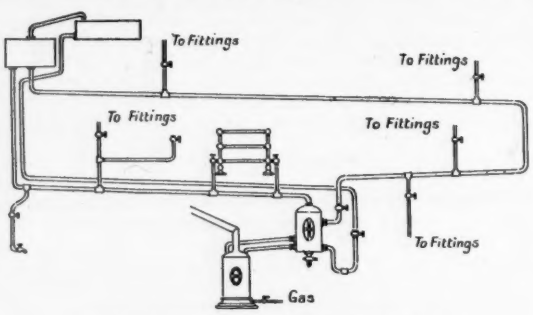


Diagram D.—The Cylinder Tank System.

this is not really essential. The system is very suitable for houses where the sanitary fittings are scattered about or fixed some distance away from each other. It is particularly suitable for hotels and public buildings.

Low-Pressure Steam System.

Diagram E shows a combined system of heating buildings and supplying domestic hot water by means of low-pressure steam. This system, in conjunction with the gas-fire, will, I think, be largely used in the future in this country. It has been very successfully installed in the States and Canada. The diagram shown is a system designed and fixed by Mr. T. Hughes, of Warrington. The piping is practically the same as that required for the cylinder tank system of hot water supply. The hot tank shown in dotted lines may be left out if not required.

Steam is generated in the gas-boiler to a pressure of from 3 to 5 lbs. It is then carried to the calorimeter and passed through a coil; the condensed water being returned to the boiler at a high temperature, to be re-converted into steam and sent again through the calorimeter. For heating buildings, the steam may be carried direct to the radiators and returned back again to the boiler. When the steam is carried direct to the radiator the pipes must be carefully proportioned and proper falls be given for the return of the condensed water. It is also important to remember that changes in temperature are most marked in any steam-heating system. Therefore ample provision must be made for the expansion that takes place in the piping.

A calorimeter may be employed, as shown in Diagram E—the steam transferring its heat to the water circulating through the radiator, which, in turn, gives heat to the surrounding objects.

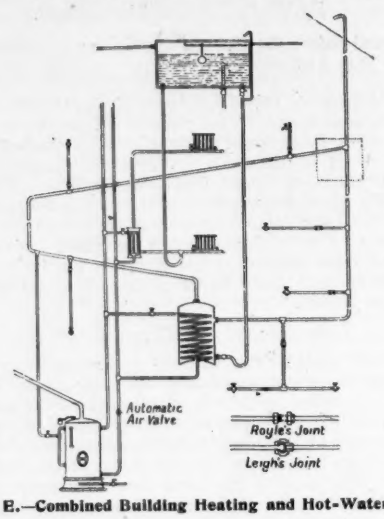
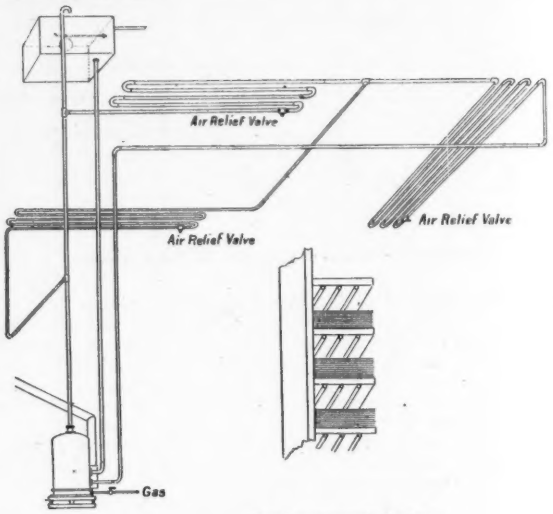


Diagram E.—Combined Building Heating and Hot-Water System.

Diagram F shows a system of piping connected to a gas-boiler fixed for the purpose of drying paper bags during the process of manufacture. The pipes are carried beneath the racks that are fixed for the bags to dry upon. This shows upon a much larger scale the principle advocated earlier in the paper for the airing of linen cupboards.



Section through Shelves.

Diagram F.—Installation for Drying Paper Bags.

Diagram G shows a system of domestic hot-water supply quite recently installed at a Nurses' Hostel in Birmingham. This apparatus is designed to supply hot water for eight baths per hour, and all the hot water required for culinary purposes.

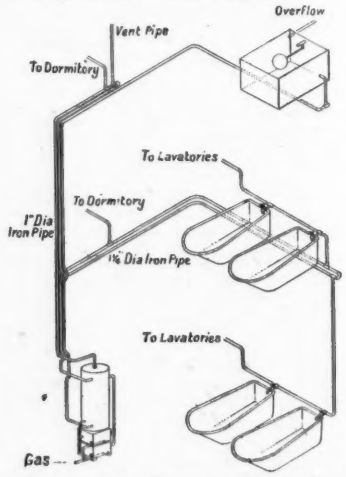


Diagram G.—System of Hot-Water Supply at a Nurses' Hostel.

The next system that I want to call attention to is one for heating purposes only, which was installed in a large Birmingham

café. I regret not having a diagram of same. However, the apparatus consists of two large gas-boilers and twelve radiators, each having 20 square feet of radiating surface. The flow and return hot-water pipes are covered with non-conducting material. The apparatus is designed on what is known as the accelerated system, which consists in the flow pipe being carried direct to a small closed tank (which tank is also covered with non-conducting material) fixed above the highest radiator. From this tank two return pipes are taken round each side of the café, by which the water flows by gravitation back through the radiators to the boilers.

The last three examples are typical of many more gas-heated hot water supplies that have recently been fixed in Birmingham and district. I would have liked to have shown diagrams of some others; but I must be content by simply stating the purposes for which they are being used, so that you may see what a scope there is for future work.

A large system was installed at a girls' high school to give hot water for twelve baths, to be taken each evening between the hours of 6 and 8 o'clock. In addition to this, they supply the water for three ranges of four lavatory basins. Another system was installed at a large ham and bacon curing factory, where great quantities of hot water are required for scalding purposes. Also a system was designed and fixed for supplying hot water to a printing and book-binding establishment, where large quantities of hot water are constantly required for washing ink from the printers' apparatus.

The most suitable material for domestic hot-water work I consider to be tinned copper. It is a good conductor of heat. Its elastic properties are not greatly diminished by being subjected to various temperatures. The pipes do not sag and form air pockets between the supports. With a little care it can readily be bent to suit any angle. It is easily jointed together by means of pressure joints, see Diagram E. These joints stand very well for medium pressures. Water has little or no action upon it.

Gas Heated Circulators in Conjunction with Existing Ranges.

The installing of gas-heated circulators to work in conjunction with existing coal or coke fired ranges is not the simple matter that some manufacturers of gas circulators are inclined to think (judging from their advertisements). No, a little more is required than the insertion of two tees into the existing pipes. By far the best method is to connect the gas-boiler direct to the storage chamber, as shown in Diagram H. There are very few cases where this method is impossible. In cases where it is necessary to connect to the existing pipes, then webbed or Y-shaped tees must certainly be used, as shown in Diagram I. Failure to observe this simple rule has been the means of condemning more than one gas-heated boiler—in fact all sharp elbow bends or anything that will tend to interfere with the free circulation of the water must be avoided.

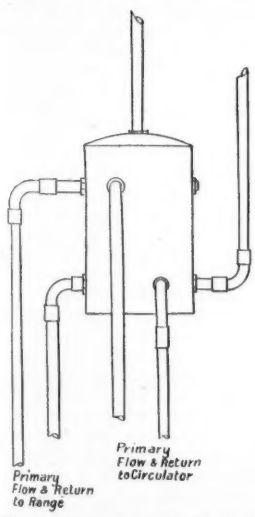
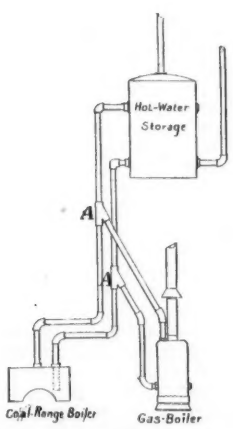


Diagram H.—Showing Separate Connections for Gas-Heater.



A.A.—Webbed Tees for Connecting Gas-Circulator to Existing Pipes.

Diagram I.

Inter-circulation between the two boilers will readily take place without being assisted by faulty fixing. This inter-circulation often closes-down the thermostat which regulates the gas supply before the water in the storage is warmed through. Again, the capacity of the storage chamber must be carefully considered. It will often be found that a storage of 60 or 80 gallons has been provided, which is much too large for the average installation. So consumers must be shown that a 30-gallon cylinder would be more suitable for their requirements, and that if the existing arrangements be left, they will be heating-up each day more water than they require, which, needless to say, will have a marked effect on the gas bill. A suitable gas-boiler for storing 30 gallons would be one consuming about 40 cubic feet of gas per hour. Thermostats or automatic gas-valves are excellent devices. I would strongly recommend their use on all new installations of hot-water work.

Essential Features for Hot-Water Plant.

In conclusion, let me say what I consider to be the most essential features for a successful gas-heated hot-water apparatus.

1.—A good gas supply.
2.—A proper flue to take away the products of combustion.
3.—A good boiler, fixed as near as possible to the storage chamber.
4.—A proper system of piping.
5.—A storage chamber of suitable size, and covered with non-conducting material.
6.—That no stop-valve of any kind be inserted in the primary circulation pipes.

I have purposely refrained from mentioning any of the very many excellent instantaneous water heaters that are at present on the market, believing that these in themselves would form a suitable subject for some future paper.

DISCUSSION.

Mr. Cobb prefaced the reading of his paper by remarking that there were many points in connection with the subject which considerations of space had compelled him to omit mention of. He had assumed that the members were more or less conversant with the principle of the circulation of water; for it was upon this that the success of the kind of work referred to mainly depended. The character and substance of the practical part of the work were, of course, of very great importance; but the effects of the best workmanship were often neutralized by ignorance as to the effects of heat upon water. Circulation of water was the result of an unchangeable law of Nature—the law of gravitation. If there was a pipe taken from the top of a boiler, with a rise to the point farthest from the boiler, and then a return connected to the bottom of the boiler, the application of heat would cause the water to circulate. It was not necessary that the water should boil, or even approach boiling-point, to cause circulation. In properly constructed apparatus, circulation commenced immediately the temperature of the water was raised in the boiler. Therefore it was clear that the motive power which produced circulation was the difference in weight of the two columns of water in the flow and return pipes. When they considered that the difference in weight of two columns of water each 12 inches high and 1 square inch in area was only 32 grains with one column at 172° and the other at 202° Fahr.—*i.e.*, a difference in temperature of 30°—it would be seen how small a motive power there was to overcome inertia, friction, and the resistance offered by the use of elbows, &c. Neither had he considered the many advantages of the gas-boiler for producing increased gas consumption. What he did hope to show was how the gas-boiler readily overcame obstacles which in the past had presented great difficulties to the hot-water engineer. Referring to the pressure due to the head of water, he said this was a question of great importance when considering a gas-boiler. In order to take out all the heat units from the gas, large boiler areas were exposed to the flame; and to secure these large areas complicated castings were necessary. Weak points might creep in which these great pressures soon found out. The matter might be aggravated by deposits which were non-conductors, thus causing the boiler surface to get hot and gradually burn away.

The President (Mr. F. J. Ward, of Knowle), inviting discussion, remarked that the paper was one which would be of great use to them, and its value had been enhanced by the excellent series of antern slides by which it had been accompanied.

Mr. F. Shewring (Droitwich) said his experience of gas circulators and boilers in houses for domestic use was that where they had been fortunate enough to instal them, they had proved very helpful in increasing the consumption of gas. In one case, for one quarter the increased consumption was equivalent to twelve months' gas consumption at the same house prior to the installation of the hot-water boiler. In most instances where they had installed a heater for the boiler, they naturally endeavoured to get a cooker in at the same time, which of course resulted in further increased consumption of gas. He did not think they could really term gas-heated installations economical if they were going continuously (say) during the summer months, which was the time when they were used most in conjunction with the cooker. He had had one case in which the consumption was so considerable that the people had hesitated about continuing the use of the heater; and where he had reason to think that a big consumption (which, he found, followed the adoption of these boilers) was an important matter for a customer, he preferred to fix geysers for baths and lavatories, &c. Though, perhaps, in some instances the cost of installation of these direct-heating appliances might be higher, they would be found more economical in gas consumption. At the same time, he could readily admit that they might be regarded as not quite so convenient, although, as a matter of fact, one could get a bath in from ten to fifteen minutes and hot water in a lavatory basin in two or three minutes. He thought, also, this was a better method for private dwelling-houses, where they happened to be called in to deal with a system of pipes that was known to be faulty. He remembered an instance in which a customer wished for a hot-water circulator to be connected to his existing pipes; and he disclosed the fact that he could not get his boiler to work. Inspection showed that there was a long

length of piping to the bathroom from the range, and an old type of boiler. On going into the question, the customer did not seem inclined to incur the expense of having the system overhauled, and so he dealt with the matter by fixing direct-heating appliances at the different points required—a scheme which had resulted in great satisfaction. He quite agreed that the "Y" connections were much more suitable for connecting to existing pipes than the ordinary "T" pieces. Sometimes gas-boilers were fixed in the scullery or kitchen, and one could arrange the piping to the adjoining flue in such a manner that, with a wire contrivance above, it could be very conveniently used for airing clothes, drying towels, and so on. This was a somewhat inexpensive arrangement which would be greatly appreciated in the household.

Mr. B. J. Bell (Birmingham) said the paper had shown them once again that the distribution man had now a little more to do than was the case a very few years ago. The importance of apparatus such as the author had been dealing with was becoming more and more generally recognized, because of the great increase in the consumption of gas which it brought about. They must admit that at present such appliances were to a large extent luxuries on this account; and their future really depended upon the prices which were fixed by the gas industry for the commodity supplied. It was almost marvellous that the time should have so rapidly come when the ordinary gas-burner consuming a few cubic feet per hour, should be giving up its position of primary importance to apparatus which consumed large quantities of gas, even in ordinary houses. He often wondered whether the time would arrive when a boiler such as Mr. Cobb had been dealing with would be fitted in the basement, not only for hot-water supply, but for heating the house as well, on the system adopted in other parts of the world. In America, he believed, the system of heating by water was almost universal, though he did not know that the boilers were heated by gas. Still, some way had been traversed; and in the future there might be a time when the gas engineer would be the heating engineer for the house as well. Brief reference was made in the paper to thermostats; and he agreed that these were a most important item in the installation. But there was still some doubt as to which was the best type, and where it should be fixed. At present they were faced with the difficulty that circulators such as had been dealt with were not altogether the thing that could be fixed in every case. Often it was only bath water that was required; and in this event a geyser must be adopted. It must be admitted that all this had tended to increase the quantity of gas used per meter, and to bring about a state of affairs in which it was necessary to deal very differently with the supply-pipes to a house. If this system of heating water were generally adopted, the present arrangement of services and meters was entirely out of date, and the time would come when the meters in dwelling-houses would be more like factory meters than what they now had.

Mr. G. Ball (Saltley) remarked that the paper was the outcome of great experience in this particular class of work. Of course, the system of water heating by gas was most elaborate in every way now, compared with (say) 33 years ago, when he (the speaker) had the pleasure of fixing in Birmingham a small gas-circulator which he believed was about the first put in. They put everything together in the shop themselves. The system was for supplying hot water for spirits at a large establishment in the town; and the idea was to get hot water quickly. It was decided to have a small copper boiler made, to hold 2 quarts. There was also a reserve tank which contained the same amount; and he thought the cold water feed was a little, but not much, larger. A ½-inch burner was fitted, which was also made in the shop. The arrangement was put to work, and went on very successfully for ten years. There was one tap on the circulating pipe; and the only tap to stop the supply was the ball-tap, so that there was no fear of anyone turning it off. The unfortunate thing about the system was that the small boiler used to get burnt away very quickly. When the establishment was re-built, the whole thing was put in on a much larger scale. A Fletcher boiler was fixed, and the system renewed throughout; and it continued to give complete satisfaction. This showed that the Birmingham Gas Department had an idea of what was coming along in regard to hot-water circulators. In the last ten years greater strides had been made than ever before. Of course, there were circulators for greenhouses thirty years ago; but they could not get people to take them up, because whenever anything went wrong with the plants the gas was blamed for it. He did not think they would get many greenhouses. The system the author had shown was no doubt the right thing, particularly in the summer time.

Mr. G. M. Lewis (Birmingham) said the question of hot water had been, as Mr. Ball had pointed out, before them many years; but it was only of late years that the manufacturers of apparatus had found there was a very large demand, and that they must get out some newer appliances than the Fletcher greenhouse boiler of years ago. Mr. Ball had forgotten that at present they were doing a very big business in Birmingham in heating both greenhouses and garages with hot-water circulators. It seemed to him that makers would do well if they would give them an apparatus which would come out at about half the price of the present cast-iron apparatus. Could Mr. Cobb give them, from his experience, some idea of what advantages were possessed by gas over coke for this class of heating? With coke apparatus it was possible to get for perhaps 25s. a boiler which was really satisfactory. It seemed to him that the question of cost was rather against the gas-heated system. He was particularly interested in what he thought was a strong point that should be made more of. This was the question of laying a special pipe, if possible, from the apparatus direct to the hot-water tank when installing a gas-heated circulator. If this were done, they would get rid of the trouble of bad circulatory systems; and it would not be necessary to have a geyser fitted to reduce the expense. It was quite easy to heat up the tank, draw off the bath, and turn the circulator out. There would not be much difference in the cost. With a good circulator, they got 70 or 80 per cent. efficiency, and one could not expect more from a geyser.

Mr. R. J. Rogers (Birmingham) remarked that when he had been looking through the "Transactions" of the Association, he had often noticed that there was something missing The important question of hot-water supply by gas-heated circulators had never been made the subject of a paper. Therefore Mr. Cobb's contribution would be particularly useful. They all realized now that hot-water supply was going to help gas sales very considerably; but to his mind at the present moment they were faced with certain difficulties, which perhaps varied in different parts of the country. He referred to the question of the gas-fitting and the plumbing trade in relation to the fixing of these water appliances. This trouble probably did not exist in the North, because there the gas-fitter was also a plumber; but in the Midlands and the South this was not necessarily the case, the two trades being more distinct. Thus the question had repeatedly cropped up, not only in Birmingham, but in many other towns, as to whether the gas-fitter should fix these appliances. He (the speaker) did not see any reason why he should not do this pipe work—that was, beyond the lead work. The plumber should certainly keep to his side, which was the lead work; and the running of the iron pipes between the gas water-heater and the tanks, &c., should be undertaken by the gas-fitter. While these difficulties were occurring, they were losing business; and he knew that the subject was receiving considerable attention. It did seem that if they were going to make the very best out of the hot-water business, some definite arrangement should be come to by the whole of the industry as to where the gas-fitter should commence and where he should finish. Then there was another difficulty militating somewhat against the success of these boilers, and this was the construction of the boilers themselves. It was, again, a local matter. Boilers which were suitable (say) for Birmingham, might be quite unsuitable for other parts of the country, and *vice versâ*. The author had stated what he considered to be the most suitable material for hot-water work—tinned copper. It was undoubtedly the best material; but it was expensive. Mr. Lewis had touched on the question of the cost of these appliances. It would, of course, help matters considerably if the makers could produce a much cheaper article; but he did not quite see at the moment how this was to be done, because cast-iron circulators were supposed to be the cheapest. The particular form in which they had to be cast made the work somewhat expensive; and he did not see how the cost was to be reduced to any considerable extent. Then there was the question of the action of water on these circulators. The Barffing system had been suggested, and the apparatus had been subjected to the Bower-Barff process; but he was informed that, notwithstanding the Barffing of the boilers, they in a very short time showed marked signs of deterioration owing to the action of the water. He was, of course, referring to their own district. At one time, he thought that cast aluminium might be a suitable material from which to manufacture these circulators. He had carefully watched in use for twelve months domestic water heating utensils of this material; and he failed to find any signs of deterioration in them, either from the action of the gas or of the water. But recently aluminium pipe which had been in contact with plaster or lime under the files of a hearth was found to have deteriorated considerably. It was quite eaten away by the action of the lime on the aluminium. Therefore he did not think in districts where there was a lot of lime, the aluminium gas-boiler would be suitable. But it was worth experiment in some districts where the lime might not be a source of trouble. Mr. Cobb had rightly laid stress on the necessity of looking carefully into the existing circulating system in a house before deciding how to proceed. In many cases where the expense of gas was complained of it was because sufficient care had not been exercised in the first place in examining the existing circulatory system; and it was becoming increasingly necessary in large towns to appoint specialists to look after this side of the business, so that the most suitable system for the circumstances might be adopted. As to Mr. Shewring's remarks, from the point of view of efficiency the instantaneous heater stood much higher than any circulating system, because, of course, they had the circulating loss. The conditions of each case must guide them as to which method to recommend.

Mr. W. E. Cadwallader (Birmingham) said the author told them that the cold-water pipes should all be taken from the town supply. In quite a large number of places, he (the speaker) had noticed that the cold-water taps in the bathroom and for the lavatory basin had been taken from the cold-water cistern at the top of the house. Was there any objection to this, providing it was not taken from the feed-pipe to the boiler? He saw in one part of the paper, Mr. Cobb said some manufacturers seemed to think the apparatus would work quite well simply with the insertion of two tees into the existing pipes. It seemed a great pity that the makers should put these statements about. It made it very hard to induce people to go to a little more expense to get a

good job. Already it was quite hard enough to get some of these things placed, without further difficulties being put in their way by manufacturers. Mr. Cobb said the cold-water cistern should have a good-sized overflow-pipe discharging into the open air. Could he suggest any way of preventing cold air passing up this pipe and freezing the water in the cistern?

The PRESIDENT, proposing a vote of thanks to the author, said he would have liked some comparison of the cost of heating water by gas, coke, and coal. This, of course, affected the matter very considerably.

Mr. ERNEST SCEARS (Rugby), who seconded the vote, pointed out the importance of everyone connected with the industry, and particularly those on the distribution side, being well up in all things connected with hot-water circulation. When they were asked to fix a gas-circulator, it was in many cases because the existing installation was not working successfully—not due so much to faults in the coal-range as to defects in the circulating system; and it was no use expecting a gas-circulator to work well on a system with which coal had failed. Therefore all who had to do with this sort of work should understand the principles of hot-water circulation, and be able to put the system right before the gas-circulator was fixed.

Mr. COBB, after acknowledging the vote of thanks, proceeded to reply to the points raised in the discussion. He said that several of the speakers seemed to think that gas was an expensive fuel for water-heating systems. He would hardly have expected an argument like this to have been raised in such an assembly. Gas was not an expensive way of heating water. If they were going to calculate it on the amount of heat units given out by the same value of coal and gas, then it probably was expensive; but considering the more useful effect they could get out of gas, as compared with other fuels, it was not expensive. These things had not to be judged by their face-value, but by their useful value. He defied anyone to get a cheaper bulk of hot water than was obtained with a gas-heated installation of which he exhibited a diagram at the meeting, and which he said was typical of many installations to be found in Birmingham. In this the circulating pipes consisted of 20 feet of 1-inch flow and 20 feet of 1-inch return. There was a 60-gallon supply tank and 30-gallon storage. They had continually got 30 gallons of water raised in temperature 60° Fahr., every half hour, for 1d. or less, taking gas at 2s. 1d. per 1000 cubic feet. It was quite impossible to supply so cheaply by coke or coal small quantities of hot water. Mr. Shewring had referred to the distribution of geysers at required points. He (the speaker) had been impressed with this idea; but the first cost of the system must be very high, because the majority of geysers were of copper, which was an expensive metal. Then there was the construction of flues. On the whole, he did not think it would be a more economical proposition than the fixing of a central gas-heater and taking the water through a system of tanks. The suggestion to use the flue of a gas-boiler for drying towels was not one he would care to adopt. All flues from circulators should be as short as possible, to get them into the chimney as soon as practicable. They should not be run round the room for the purpose of utilizing the heat. Deposit falling back from the flue on to the circulator burner tended to render it inefficient. As to meters, he knew a house in which everything was done by gas, and there was only a 10-light meter. All the appliances were not likely to be in use at one time. At any rate, nothing larger than a 20-light meter was likely to be required for a domestic supply; and he did not think this would be troublesome in any house. The late Mr. Thomas Fletcher had his first boiler fixed in a greenhouse 36 years ago. Greenhouse heating by gas was still going on, and several installations had been sold in Birmingham within the last few weeks. It was undoubtedly a shame that a plumber should be called in to fix a gas-boiler. This was the work of a gas-fitter. He had no hesitation in saying that, with the installing of circulators in Birmingham, the cost was increased 25 per cent. by having to bring in a second party, who could not do the work any better. It did not seem to him that geysers were any more efficient than circulators. There was a large surface exposed with a geyser; and with circulating tanks covered with non-conducting material, this system should be quite as efficient. There was no objection to supplying cold water to baths and lavatories from the feed cistern, provided it was carefully protected from contamination; but he preferred cold-water supplies to be taken direct from the town main. In any case, there should always be a tap direct from the main for drinking. While some makers suggested connecting circulators to existing pipes, he found others strongly advocated separate connections. He did not think there would be much draught with a ½-inch or ¾-inch waste-pipe; but a flap could be put over it. It had been said that a coke-boiler cost 25s.; but this seemed much too low. For very large heating installations, there was no doubt that coke would be cheaper to use; but he could recall many complaints of the coke-boiler, ranging in gravity from the tarnishing of silver plate to the disturbing of the sleep of the lady of the house by the stoking of the boiler. Then there were the fluctuating temperatures, dust, &c. Contrast all this with the gas-boiler, with its ease of control, and other advantages.

We have received from Messrs. Crosby Lockwood and Son a copy of "Water Supplies: Their Purification, Filtration, and Sterilization." The authors are Dr. Samuel Rideal and Dr. Eric K. Rideal, B.A. The work is published at 7s. 6d. net. A more extended notice of the book will appear in an early issue.

SCOTTISH JUNIOR GAS ASSOCIATION.

EASTERN DIVISION.

The Second Meeting of this Association for the present session was held at Kirkcaldy last Saturday—Mr. R. B. CHALMERS, the President, in the chair. Owing to the state of the weather, which was very boisterous, there was not a large attendance.

The proceedings having been formally opened,

Mr. HENRY RULE (Kelty) read the following paper.

A FEW NOTES IN CONNECTION WITH GAS-WORKS PRACTICE.

In presenting the following notes, I must first of all say that I chose the subject as one which, so far as my recollection serves me, has not already been before you, and would at the same time be fruitful of discussion.

SIZES OF WORKS.

Glancing over the statistics given in the "Proceedings" of the North British Association of Gas Managers for the past year, I find that out of 193 works which have sent in returns 21 make over 100 million cubic feet, 21 over 50 and under 100 millions, 22 over 30 and under 50 millions, 34 from 15 up to 30 millions, and 95 (or roughly 50 per cent.) up to 15 millions.

CAPITAL EXPENDITURE.

The next point is the great difference in capital expenditure per million cubic feet produced in the various works. That the amount of this, whether in excess or the opposite, has its effect on the ultimate selling price, no one will deny. In works making over 90 million cubic feet, which have given capital expenditure:

One has	capital	over	£900	and	under	£1000	per million.
Two have	,,	,,	800	,,	,,	900	,,
One has	,,	,,	700	,,	,,	800	,,
Two have	,,	,,	600	,,	,,	700	,,
Four	,,	,,	500	,,	,,	600	,,
Three	,,	,,	400	,,	,,	500	,,
Seven	,,	,,	300	,,	,,	400	,,
Six	,,	,,	200	,,	,,	300	,,

So that 50 per cent. of the above are below £400 per million cubic feet; and it is interesting to note that these include the four works supplying gas at under 2s. per 1000 cubic feet. Seven out of the ten supplying gas to ordinary consumers at 2s. 7d. per 1000 cubic feet or over have capital at or above £600 per million cubic feet. In works making 50 and under 90 millions, one has a capital of over £600, one over £500 and under £600, and three over £400 and under £500. Although here the two supplying the cheapest gas have not the lowest capital, they are well under £500.

I believe there are at least 15 gas undertakings in Scotland that have either adopted vertical retorts, or are at present erecting them; and looking over the capital expenditure of these works, I find that 13 of them were below £470 per million.

I am of opinion that a firm and watchful eye should be kept on the capital expenditure, so that works would be in a position to adopt at any time new plant, and thus take fullest advantage of the opportunities to supply their commodity at the cheapest possible price, without at the same time unduly inflating the value of the undertaking.

In the case of my own Company, we pay for all gas-stoves out of revenue, and have done so ever since their hiring-out was inaugurated by my predecessor. We have an arrangement with the stove firms whereby the cost of each cooker is spread over five years; and there is a special item in our revenue account for income-tax purposes. The payments are as follows:—

		Pence per 1000 Cubic Feet of Gas Made.
1907–08	£149 3 3	2·52
1908–09	253 10 11	3·66
1909–10	271 7 4	3·72
1910–11	375 16 8	4·21
1911–12	400 11 4	4·24
1912–13	346 9 6	3·48
1913–14	299 0 3	2·58

It may be argued that these costs came out of the consumers' pockets, and that they were paying too heavily at the time. I hold, however, that as soon as these are wiped off the consumer begins to benefit—and that more quickly than if we had raised capital for the purpose, and were still paying interest on it. I do not mean to infer that every works is in a position to do as we have done; but, as will be seen from the following statement, our works has increased fairly rapidly, and we have been able to reduce the price of gas from 4s. 2d. to 3s. 8d. per 1000 cubic feet for ordinary consumers, and abolish meter and stove hires.

Year.	Make. Cubic Feet.	Capital.	Capital per Million Cubic Feet
1907–08	14,230,000	£12,000	£843
1908–09	16,628,000	12,000	722
1909–10	17,480,000	13,000	744
1910–11	21,420,000	13,000	607
1911–12	22,685,000	13,700	604
1912–13	23,972,000	13,200	550
1913–14	27,840,000	12,950	465

HIRING OF STOVES AND COOKING APPLIANCES.

We have out on loan in Kelty a considerable number of heating appliances—viz., cookers, hot-plates, and boiling-rings; the pro-

portion being 1 to 1·65. I was interested to find out what other works were doing, and if I was getting the results per consumer I should be getting.

	Proportion of Cookers to Consumers.	Gas Sold per Consumer. Cubic Feet.	Price of Gas (Ordinary). s. d.
A.	1 to 7·41	19,060	2 3½
B.	1 ,, 5	17,080	2 11
C.	1 ,, 4·75	16,800	3 4
D.	1 ,, 4	15,900	3 2
E.	1 ,, 5·5	15,070	2 3½
F.	1 ,, 3·06	15,300	3 4
G.	1 ,, 3·64	13,740	4 1
H.	1 ,, 1·6	13,580	4 2
I.	1 ,, 1·65	13,050	3 10 (Kelty)
J.	1 ,, 1·59	12,760	3 9
K.	1 ,, 2·86	11,700	2 9
L.	1 ,, 7·42	11,350	2 11
M.	1 ,, 1·17	11,290	3 9
N.	1 ,, 1·58	10,140	3 9
O.	1 ,, 2·11	9,500	4 2
P.	1 ,, 7·2	8,520	3 9

In arriving at the gas sold, I am aware that my figures are not strictly accurate, as I have deducted from the gas made street lamps at 7000 cubic feet a year, gas used on works at 1 per cent., and the leakage as given in the statistics. Before coming to any comparison in regard to the above results per consumer, the price of gas, the class of people, the industries, &c., in the particular district have to be taken into account. At the same time, and taking these into consideration, the result in Works A is so high as to lead me to believe that the figure given in the statistics must represent only the cookers, and not the total cooking appliances in use in the district.

Here let me say that it would be of much more value if the column in the statistics headed cookers were changed to cooking appliances, and, further, that as gas-fires are becoming so popular an additional column might be inserted for these.

Fully three years ago I induced my Directors to abolish stove hires. Previous to my appointment I was a firm believer in charging rent, but after a year's experience in a mining district I was forced to change my mind. My reasons were:

(1) Great difficulty experienced in collecting stove hires from slot consumers. The difference between the money in the box and that charged for the gas was not sufficient. The migratory nature of a certain class, too, made matters more difficult.

(2) When a new consumer came into a house where a stove was fixed, we were often asked to remove it on the consumer being told there was rent of so much to pay. Now we generally find that the cooker stays and is used, and thus we are saved the cost of removing and cleaning—often amounting to several shillings.

(3) When a party came into a house where there was a large stove at about 7s. a year, we were often asked to substitute a smaller one at 4s. a year, or remove it altogether. Result, the gas company had the cost of changing and cleaning-up, and often as much as a year's hire was gone in expenses.

I do not know whether or not the abolition of stove hires has directly been the means of increasing the consumption per consumer; but I may say that in 1909-10 we had 1340 consumers and 480 cookers, and an average consumption per consumer of 10,462 cubic feet. In 1913-14, we have 1804 consumers, 1095 cooking appliances, and an average consumption of 13,050 cubic feet per consumer. The effect, too, that they have had in the summer consumption is considerable:—

	Gas Made. 1909. Cubic Feet.	Gas Made. 1910. Cubic Feet.	Gas Made. 1914. Cubic Feet.
May	882,200	1,114,800	1,779,000
June	766,400	1,069,500	1,700,000
July	842,000	1,178,900	1,856,000
Aug.	1,091,700	1,389,900	1,986,200

Unaccounted-for Gas.

The next item that we might study from the statistics is leakage. It does not always follow that the lowest percentage in leakage means the lowest per mile of mains, as will be seen from the following towns, taken at random:—

Town.	Leakage. Per Cent.	Leakage Per Mile of Main. Cubic Feet.	Consumers Per Mile of Main.
A.	2·48	105,900	186
B.	4·97	127,700	285
C.	4·53	132,100	130
D.	8·13	155,900	77
E.	10·0	164,800	64
F.	2·83	195,400	213
G.	11·0	197,000	148
H.	3·9	200,200	194
I.	6·3	208,300	178
J.	7·5	232,700	188
K.	7·01	251,600	141
L.	6·11	276,300	213
M. (Kelty)	11·26	331,000	190
N.	7·0	333,100	238
O.	8·45	370,400	208
P.	10·2	374,900	219
Q.	9·0	375,200	306
R.	15·0	382,400	169
S.	8·0	398,700	144
T.	10·0	416,600	209
U.	8·9	432,300	273

The results above show that two works with a relatively high percentage of leakage have very much lower results per mile of main than many with lower percentage—indeed, so varied are the results when tabulated in order of leakage per mile that it gives rise to the question: Is the percentage on make the most correct way to record unaccounted-for gas? Here, in passing, I deprecate very much the practice by those in authority, when interviewing applicants for gas managerships, of placing too much stress on leakage results, whether high or low. There are so many circumstances to be taken into account—character of the district main mileage, consumption per mile of main, and so on—which outsiders cannot appreciate in a few moments.

Our district contains a good many side streets, branching off the main thoroughfare; and there is a valve in each. I had a ½-inch pipe connected on each side of the valve, and brought into the surface box covering the valve spindle—so making the testing of the street an easy matter. This has been of considerable value to us in localizing leaks in portions of the district affected by underground workings. By systematic testing we have brought down our leakage from 15·35 per cent. to 11·26 per cent.

Sulphate of Ammonia Plant.

To make the most out of our residuals is the aim and object of us all, and some time ago I went into the figures in connection with a sulphate plant to see if I could bring increased gains in this direction. I made up the following balance-sheet:—

Cost of House and Plant—say, £700.	£ s.	Per Ton of Sulphate Made. s. d.
Interest, 5 per cent.	35 0	24 1·7
Repairs to house and plant	10 0	8 3·3
Acid, 29 tons at 35s.	50 15	35 0
Wages (manufacture)	23 4	16 0
Lime	3 10	2 6·6
Steam (water and fuel)	10 0	6 10·7
Total annual expenditure	£132 9	£4 12 10·3
Revenue from sulphate.		£ s. d.
At 22 lbs. per ton of coal—say, 29 tons at £11 10s. at works net and naked		333 10 0
Gross profit		£201 1 0
Tar and liquor sold, 149,787 gallons		£454 15 8
Deduct tar at 10·25 gallons = 30,360 gallons, at 18s. per 100		273 4 10
Net value of liquor		£181 10 10
Profit by making sulphate		£19 10 2

It is to be noted that this takes no account of depreciation, which at 2½ per cent. on house (£300) and 3 per cent. on plant (£400) would come to £19 10s. I could not see then, so far as a distillation plant was concerned, that we could gain anything by adopting one; but if any of you can assist me to come to any other conclusion, I shall be happy to again consider the question. Meanwhile I am waiting further results in connection with the direct recovery process, which plant appears to me to be more suitable than the distillation plant for small works and being cheaper also in first cost.

Storage Capacity.

In comparing this with the maximum daily make, we find marked differences, particularly in the larger works—so much so, that it gives rise to the question: What is the proper proportion of holder capacity? The old maxim that storage equal to the maximum day's production is necessary, while perhaps still applicable to works where large carbonizing units—*i.e.*, vertical retorts or chamber ovens—are in use, seems to me to require some modification or qualification. The difference between the day and night load is not so marked to-day as it was a few years ago; and while each district has to consider its own peculiar circumstances, I believe, speaking generally, that 75 per cent. of the maximum day's production will be found safe enough.

In the 26 largest works in Scotland, 14 have storage either more than, or equal to, their maximum daily make, four have over 90 per cent., one over 80 per cent., two over 70 per cent., four over 60 per cent., and one over 40 per cent.

In my own case, four years ago, the proportion was 61 per cent.; and at that time my Directors started a reserve fund, in view of the increasing consumption. Last winter the proportion was 50 per cent.; and we are at present erecting a new holder (one lift of 50,000 cubic feet, prepared to take a second lift at any time) out of this fund, and so saving an increase of capital. Had we put up this holder when the proportion was 70 per cent., we would have been paying 5 per cent. interest on (say) £1800 for five years, equal to £450, or at the rate of over 1d. per 1000 cubic feet of gas sold, to say nothing of the cost of periodical painting and depreciation.

While an additional holder might have brought a certain freedom from anxiety for the men, I could not see that at the time any possible saving would counterbalance the expenditure; and this, after all, is the testing point.

Gas-Fires.

We have not yet reached the stage of hiring-out gas-fires in Kelty. In a district where miners get coals at a reduced figure, and the price of gas is 3s. 8d. for ordinary and 4s. for slots, we cannot hope to compete on the score of running cost alone. I

believe in being perfectly candid with consumers who inquire as to what quantity of gas a certain size of fire suitable for a particular room will consume. Nothing will do more harm than for a consumer to find at the end of a quarter that the bill has far exceeded his expectations. At the same time, however, I emphasize its cleanliness, hardiness, and great saving in labour. By studying each consumer individually a great deal can be done if our remarks are of the right kind, at the right time, and in the right place. We have put out a good number of fires in bedrooms and other rooms not in constant use, and these we supply at cost price, and fix up a reasonable extent of piping free.

Maintenance of Consumers' Burners.

In regard to this, the amount done in different places varies very much, though it will be generally agreed that companies do more than corporations. I think our attitude towards this should be that—as electricians make a great point about their light, of simply turning on the switch—we should see that the consumers' burners are properly adjusted and cleaned. It will generally be found that there are many consumers who take an intelligent interest in their burners, and keep them clean and adjusted; but there are others who do not care for even this small work.

Our fitters have instructions when attending to any complaint to see that the burners are in proper order before leaving. We also periodically clean and overhaul burners in shops, halls, schools, and churches free, charging only at retail prices for globes and mantles. Naturally this costs money in fitters' time. But who shall say it is not worth it? We have not yet any electric competition, due partly, perhaps, to peculiar local conditions; but I think it better to keep away the demand for it by giving good service and a good light, and so save bringing to mind the saying about "locking the stable door after the horse is stolen."

Stokers.

Judging from the numerous advertisements during the past few months for stokers, there appears to be a scarcity of reliable men. In a small works where the manager has to attend personally to every detail, and a foreman is an undreamt-of luxury, good stokers are absolutely essential, and well worth good wages. But are we doing our best to attract good men? I think that if a free house and so much coals and gas were provided, there would be no difficulty in securing thoroughly reliable men, who could in a very short time become proficient stokers, because I believe if you relieve a man from the necessity of saving up rent, and paying coal and gas bills, it represents to him far more than the actual amount deducted from his wages. At any rate, this has been my experience. We have two houses for stokers; and I am recommending my Directors to build a third.

Before leaving this subject, might I express the hope that among managers of smaller works there may be more camaraderie. For instance, when considering applications and before deciding on one from any particular works, inquiry should be made if the man can be spared. I would like to see less of the "every man for himself" policy, because we are all endeavouring to keep up (some with more anxiety and trouble than others) a full and regular supply of gas at the cheapest possible price to our consumers, and any efforts which tend to interfere therewith are not to be commended.

DISCUSSION.

Mr. J. Kincaid (Kirkcaldy), opening the discussion, remarked that they were all conscious that in Scotland the majority of the gas-works were small. Only 10 per cent. of them manufactured more than 100 million cubic feet of gas per annum, and half of them made less than 15 millions. He had tried to work out what the capital charges per 1000 feet of gas sold were in the first fourteen or fifteen large works in Scotland. He thought he was safe in saying that undertakings best situated in this respect worked out at only 4d. odd per 1000 cubic feet of gas sold. In Kirkcaldy, it worked out at 1s. 3½d., everything else being equal; consumers in their case having to pay about 1s. more per 1000 cubic feet for capital charges alone. There were many explanations as to how these capital charges were so high; but the quickest way to mount them up was for any corporation to purchase a good dividend-paying gas company. The question of free stoves was one that gave much food for discussion. At the present time in Kirkcaldy they were supplying gas-stoves on the ten years hire-purchase system; the rental of them being the cost price divided by 10. Therefore they were making no profit on stoves. His point in connection with the free hiring of stoves was the consumption of gas per consumer. The author was to be congratulated on giving the average consumption as results shown—an increase in four years of 250 feet for every consumer. Their average in Kirkcaldy worked out at about 15,400 cubic feet; an increase on the last nine years of 1150 cubic feet per consumer. In most cases, the average would be going down, because in the large towns they were losing large consumers, who were generating their own electricity. Referring to the erection of sulphate plant, Kirkcaldy was behind the times in this respect. It was satisfactory to note that Mr. Rule had based his yield on sulphate at 22 lbs. per ton.—he supposed all the yield that could be obtained from Fife coals. In regard to gas-fires, the price of gas in Kirkcaldy was high, and this affected them a little. Consumers, however, were finding the convenience of gas-fires; and they were fitting in more now than ever. Coming to the question of stokers, he understood that in small works there was difficulty in getting suitable men. In their own case, they had great trouble. They were the largest gas-works in Scotland where the old-fashioned hand stoking was in operation; and they experienced great difficulty with men coming from smaller works. They required different men altogether—men of much stronger physique. They had no chance to get men from other works now, and had to train their own men.

The President, referring to gas-fires, stated that they had a show-room in North Berwick, but did not sell anything. They simply showed gas appliances which any maker cared to send in. He considered this a very unsatisfactory way of working; but the Town Council did not go in for municipal trading.

Mr. J. G. Scott (Kennoway) referred to the difficulty of collecting stove hires. In supplying free cookers they had a big rush for them; but they were laying out of their money, and they would possibly find some people storing their boots in the oven.

Mr. W. Dunlop (Kirkcaldy) said that expressing leakage in percentages did not convey anything. He considered calculating on mileage gave a better idea. The amount of leakage depended largely on locality. In a mining area the mains were so badly twisted that there was certain to be a much greater leakage than in other districts. According to Mr. Rule there did not seem to be much profit in erecting sulphate plant in small works. He had often thought it would be to the interest of small companies to have a central works, and send all their tar to them. The small companies could have shares in the works, according to their make of gas. They would thus use up all their bye-products for works within a radius of (say) twelve miles of this centre. It would be much more economical than each of the works dealing with the bye-products themselves. In regard to the question of stokers, the author suggested camaraderie among the gas managers themselves; but he thought this would defeat its own object.

Mr. J. R. Moyes (Edinburgh) said he never was a party to the instalment system, as they had generally to pay a larger price for the article. He thought it better to raise the capital and purchase outright. The fire question was going to be a great matter for gas-works in the near future. Stove makers were all trying to give the best results, and to do away with the flue nuisance. He thought it would be a great advantage if stove-makers would try and standardize their fuel.

Mr. Rule, in replying to the discussion, said Mr. Kincaid had referred to the question of capital charges. The effect of this on the price of gas was very great, as one works might be supplying gas at 2s. per 1000 cubic feet and another at 3s., and the one supplying at 3s. might be making the gas into the holder cheaper than that which was selling at 2s. It was all a question of capital charges. As to vertical retorts, he brought that out to show that where works had a low capital per million they were in a position to adopt plant which would produce gas cheaper and enable them to sell cheaper. They were able to do this without bringing up the capital per million to an unduly high figure. Referring to the question of storage, he said that in putting up a new holder or adding to storage capacity the expenditure incurred would have to be considered, and where the gains were to come from. He agreed that a certain amount could be secured with good storage; but in his own case, although their proportion was only about 60 per cent., and although by Sunday morning they had a small stock, they were able by Monday night to have it all made up. He emphasized the point that if one had good carbonizing plant, and attended to selling, there should be no difficulty—provided the plant was suitable for the work—in having holder capacity equal to only 75 per cent. On the question of leakage, what he meant was, taking the gas consumed from the station meter and deducting from the gas sold by the consumers' ledgers, and allowing for street lamps, the difference was what was unaccounted for. Referring to councils opposed to municipal trading, one of the strongest arguments as to whether town councils or companies should own gas-works, was to find out what they were doing in this matter. If a town council would not go in for municipal trading, they should not own a gas-works, as they were not utilizing the privileges they had. In regard to free cookers, if they adopted the card system and put on the card the particulars of the gas consumed, they would soon find out whether a consumer was using the cooker or not.

At the conclusion of the business proceedings, the members of the Association were entertained to tea by Mr. Kincaid.

A Large Flexible Sub-Aqueous Water-Pipe.—A flexible iron tube, 3 feet diameter and about 2 miles long, is being laid underneath New York Harbour; and through it 15 million gallons of the Catskill water will run daily. The laying of this pipe presents an interesting engineering problem. The War Department requires that the pipe shall be at least 55 feet below the surface of the water. In order that this condition may be complied with, it must be sunk for its entire length in a dredged trench 11 feet to 35 feet deep, and then buried at least 8 feet beneath the bed of the bay. The pipe must, of necessity, be somewhat flexible, as it is lowered into position by sliding it down an incline plane held within a steel lattice; moreover, it must adapt itself somewhat to the irregularities of the harbour bed. The joints are first caulked with lead, and then, by an altogether new process, cold lead in small rods is forced by a powerful screw-down through threaded holes until the lead unites with that which is already in the joints. The result is an absolutely tight joint, and at the same time one which to a certain extent is flexible.

INSTITUTION OF WATER ENGINEERS.

The Nineteenth Winter General Meeting was held last Friday, at the Apartments of the Geological Society, Burlington House, W. The PRESIDENT (Mr. Thomas Molyneux, of Stockport) was in the chair. The attendance was good, considering the circumstances in which the meeting was being held.

CONFIRMATION OF MINUTES.

The SECRETARY (Mr. Percy Griffith) read the minutes of the summer meeting, held at Stockport on June 11 to 13; and they were confirmed.

ANNUAL ACCOUNTS.

The PRESIDENT moved the adoption of the accounts for 1913-14. He thought that the members who had seen the accounts would consider them very satisfactory. The balance carried to the accumulated fund was £192. The year in respect of finance was the best one they had ever had. They seemed to have turned the corner; and he believed that in future they would always have a good balance to report at the end of the year.

The accounts were adopted.

APPOINTMENT OF SCRUTINEERS.

Messrs. W. R. Jenkins and F. L. Williams were appointed Scrutineers of the balloting-lists for the election of office-bearers for the year 1915-16.

AUDITORS AND HONORARY AUDITORS.

A resolution, submitted by the PRESIDENT, elected Messrs. Wood, Drew, and Co. Auditors for the year, and Messrs. Herbert Lapworth, D.Sc., and Arthur Valon Honorary Auditors.

VOTES FOR CHARITABLE PURPOSES.

The PRESIDENT next proposed the confirmation of a decision of the Council that, from the accumulated funds, a sum of fifty guineas be subscribed to the Prince of Wales' Relief Fund, and twenty guineas to the funds of the Red Cross Society. In doing this, he said he wished to call particular attention to article 19 of their Memorandum. By this, as an Institution they were allowed to assist any charitable or benevolent institution or undertaking. There had been some doubt as to whether this article covered contributions like those now proposed, and so the Secretary had taken the opinion of their lawyers (Messrs. Church and Son) on the subject. They thought there was no doubt that the Council would be justified in subscribing twenty guineas to the Red Cross Society. As to the fifty guineas proposed to be subscribed to the National Relief Fund, as this was not an "institution" or "undertaking," there was doubt as to the legality. But looking at the matter from the practical point of view, their legal advisers did not think the Council would be taking any great risk, as it was hardly likely, having regard to the circumstances, that any member would raise such a purely technical objection. Personally, he had no qualms about passing the resolution.

Mr. C. CLEMESHA SMITH (Wakefield), in seconding the motion, remarked that he did not think any of their members would raise any objection. There was great need just now for subscriptions of this kind.

Mr. H. ASHTON HILL: The legality is quite clear as to the twenty guineas; the risk is only on the fifty guineas?

The PRESIDENT said this was so.

Mr. C. H. PRIESTLEY (Cardiff) thought the twenty guineas was intended in the first instance for the Belgian Fund.

The PRESIDENT said the Council minute book mentioned the Red Cross Society.

The motion was carried unanimously.

DR. KEMNA AND WAR-DEVASTATED BELGIUM.

The PRESIDENT mentioned that he wrote a letter of sympathy to Dr. Ad. Kemna, of Antwerp, soon after the war broke out. The reply to him (the President) miscarried; but Dr. Kemna had since written to the Secretary. The members, he was sure, would like to hear the correspondence.

The SECRETARY read the President's letter, in which he offered Dr. Kemna the heartfelt sympathy of the whole of the members of the Association in the trials and tribulations which he, along with the whole of the Belgian nation, had suffered. The work the Belgian nation had done in stemming the tide of invasion and giving the friends of justice and right time to organize, had been magnificent. Reference was made to the atrocities that had been committed in Belgium; and then the letter alluded to the lively recollection on the part of the members of the many happy hours they had spent among the Belgian people. In reply to the letter of the Secretary, Dr. Kemna said he was thankful to his friends of the Institution for the sympathy expressed in the trying circumstances. Every man, he was certain, must feel for Belgium and her terrible fate. It was a country of peace; but it was utterly ruined and devastated. The Waelham works of the Antwerp Water-Works Company had been systematically bombarded; but a scanty supply of water was being derived from an emergency plant.

Mr. A. B. E. BLACKBURN (Sunderland) remarked that, following upon this communication, he should like to propose that a subscription of thirty guineas be made to the Belgian Relief Fund. This would make the total contribution to the funds 100 guineas.

Mr. C. H. PRIESTLEY seconded the motion.

The PRESIDENT observed that he had much pleasure in putting the motion to the vote; and the members, he was sure, would take it as a vote of sympathy with the Belgian nation.

Mr. H. ASHTON HILL said it was right they should look at this matter in a sympathetic way; but as an Institution, the members must not forget that by this proposal they were increasing the illegal liability from fifty to eighty guineas.

Mr. F. W. M'CULLOUGH (Belfast) thought Mr. Blackburn's resolution might be put in the form of an instruction to the Council to consider a contribution to the Belgian Relief Fund.

Mr. BLACKBURN felt the matter should receive consideration as quickly as possible. In view of all that Dr. Kemna had done for the Institution, it would be a very graceful act to make the contribution at once. He would suggest that the matter of subscribing thirty guineas be referred to the Council for their decision.

This was unanimously agreed to.

PAPERS AND DISCUSSIONS.

There were only two papers on this occasion; but they were discussed at considerable length. The first was by Mr. J. C. BARROWCLOUGH (Batley) on "Notes on Scraping a 15-inch Trunk Main," and by Mr. C. W. S. OLDHAM (Ipswich) on the "Whitton Pumping-Station of the Ipswich Corporation Water-Works." Extracts from the papers and points from the discussions will be published in early issues of the "JOURNAL."

IN THE COUNTRY'S SERVICE.

The PRESIDENT remarked that a number of their members were serving the country in the present critical days in its history. He proposed that the Secretary should be instructed to ascertain the names of the members, associate members, and associates who were doing so, in order that the congratulations and good wishes of the Institution might be offered to them, and a welcome back again be given to them at the next meeting.

Mr. BLACKBURN seconded the motion; and it was unanimously adopted.

NEW PRESIDENT, VICE-PRESIDENTS, AND COUNCIL.

The Scrutineers reported the following elections as the result of the balloting:

President: Mr. F. W. M'Cullough (Belfast).

Vice-Presidents: Mr. Alfred Brown Ernest Blackburn (Sunderland), and Mr. S. C. Chapman (Torquay).

Ordinary Members of Council: Mr. F. J. Dixon (Ashton-under-Lyne), Mr. C. B. Newton (Hull), Mr. H. Preston (Grantham), Mr. C. H. Priestley (Cardiff), Mr. E J. Silcock (Leeds and Westminster), Mr. Harold W. Woodall (Bournemouth), Mr. J. C, Barrowclough (Batley), Mr. H. C. Head (Winchester), Mr. A. J. Jenkins (Jersey), and Mr. C. H. Roberts (Aberdeen).

Mr. M'CULLOUGH thanked the members for electing him President of the Institution. He remarked that he deeply appreciated the honour done him. He had been a member of the Institution from the beginning; and he did not think there was any member who had admired the success and promise of the organization more than he had done. He offered the members an invitation from the Lord Mayor of Belfast, and the Chairman and Members of the Water Trust, to visit Belfast for the summer meeting. He believed they would be able to interest the members there; and he hoped that the dreadful war would then be over, or, if not, that it would so far have spent itself as to enable the members to cross the Irish Channel in comfort.

VOTES OF THANKS.

Moved by the PRESIDENT, and seconded by Mr. CLEMESHA SMITH, cordial votes of thanks were passed to the Council of the Geological Society for the use of their rooms, to the Scrutineers of the ballot, and to the authors of the papers.

This concluded the proceedings.

Seasonable Advertising.

General advertising, to be really successful, must be attractive and absolutely up-to-date; and both these requirements are complied with in samples of new advertising mediums specially designed for the British Commercial Gas Association (forwarded by Mr. W. M. Mason, the Secretary), and prepared by them for the use of their subscribers. One of these is a tear-off calendar, with a topical coloured plate of a high order of merit, which will appeal alike to domestic gas and coke consumers. Another is a pack of playing cards, having on the backs a tasteful design and some letterpress suitable to the object with which they are distributed. Playing cards are an excellent means of bringing the varied uses of gas to the notice of a large section of the public. Fashions in card games may come and go, but cards themselves are popular always. Both calendar and playing cards will be in wide demand; and the proper distribution of the latter will be facilitated by a careful study of suggestions for the purpose compiled by the Association. An idea of the scope there is for these cards is to be gathered from the announcement that the Committee of the Association have presented 3000 packs to the Red Cross Society, for the use of wounded soldiers and sailors. There is another medium, which (seeing that it consists of adhesive poster stamps) we are not in the least surprised to learn has fairly "caught on," so that there is a great demand for supplies. In this series of stamps, there are a number of coloured designs, depicting various uses of gas.

EFFECT OF PRESSURE ON THE COMBUSTION OF EXPLOSIVE MIXTURES OF GAS AND AIR.

The following is an abstract translation of a paper on this subject by Herren E. TERRES and F. PLENZ which has been published in the "Journal für Gasbeleuchtung" for Nov. 21 and subsequent numbers. It is a record of work carried out in the Chemical-Technical Institute of the Technical College at Carlsruhe, under the direction of Professor H. Bunte.

It has been known since the time of Sir Humphry Davy that there were explosive limits to mixtures of combustible gases and air, and that explosion occurred only with mixtures falling within these limits. Further investigation showed that these limits were dependent upon other phenomena which influenced combustion. Combustion takes place more slowly at lower temperatures; but when the ignition temperature has been reached, the velocity of reaction in a mixture of combustible gas and oxygen is so great that explosive combustion spreads through the whole of the mixture. The mixture must, however, be such that the heat liberated by the reaction more than compensates for the losses of heat. Otherwise the flame becomes extinguished. This occurs either when the combustible gas is below a certain minimum proportion (spoken of as the lower explosive limit) or when it is above a certain maximum proportion, or a certain minimum in oxygen is reached. This latter is spoken of as the upper explosive limit. The rate of propagation of combustion varies with the percentage of combustible gas, ranging from *nil* at each explosive limit to a maximum for each mixture.

Many researches on the explosive limits of gaseous mixtures have been carried out by Bunsen, Mallard, Wagner, Bunte and Roskowsky, Le Chatelier, Boudouard, and Eitner. The absolute values found by these investigators differ, since the nature and size of the containing vessel, the method of ignition, the temperature, and initial pressure affect the explosive limits of a mixture. Therefore the figures found apply strictly only for the particular conditions in which they were obtained. Thus Eitner's investigations* were made in a Bunte burette at atmospheric pressure and the room temperature; and he took but little account of the effect of initial pressure and initial temperature. The effect of pressure on the explosive limits has not hitherto been exhaustively studied. The great importance of compressed mixtures of air and gas or combustible vapours for power purposes at the present day renders it desirable to investigate the effect of pressure on explosive limits.

The reactions which occur in combustion in the cylinder of an explosion motor are extremely complicated; and at the outset the conditions must be simplified as far as possible in any investigation. Only well-defined gases, such as hydrogen, carbonic oxide, and methane, were therefore studied; and, in addition to the determination of the explosive limits, the phenomena of combustion under pressure and the products obtained had to be investigated. The phenomena of combustion can best be studied at the explosive limits where the reaction is retarded; and the determination of the products by gas analysis is a far more suitable way of establishing and defining the explosive limit than the commonly-applied optical method of observing when the flame traverses the gaseous mixture.

Preliminary trials were made on the method of ignition and the most suitable form and size of the containing vessel, which was then kept unchanged throughout the series of investigations. These investigations refer to the effect of pressure on mixtures of air with hydrogen, carbonic oxide, and methane at the lower and upper explosive limits; the temperature and method of ignition remaining constant. Later experiments were made on variations in the initial temperature.

PRELIMINARY EXPERIMENTS.

In the preliminary experiments, the Kröcker form of Berthelot-Mahler bomb was used. It differs from the ordinary calorimetric bomb in that it is smaller, of cylindrical shape, and has two valves —one to serve as an inlet and one as an outlet. Ignition was by means of an incandescent platinum wire, as the insulation did not admit of spark ignition. The conditions of ignition were, however, kept constant; the wire being of the same length and diameter, and heated by the same current for exactly two seconds in each case. It was raised to a white heat just short of the fusing point. Some comparative experiments in a glass vessel of the same dimensions were made with spark ignition. The capacity of the bomb was 278 c.c., and its internal diameter 55 mm. The igniting wire was in the centre.

The first experiments were made with mixtures of air and hydrogen. The unburnt or burnt gas was determined by measuring the reduction of pressure in the bomb, and not by ordinary gas analysis. Air measured from a burette was forced into the bomb until the initial pressure was again attained, and the percentage of combustion of the mixture was calculated from the factor:

$$\frac{v \times 100}{\frac{J}{100} \times p \times 1{\cdot}5}$$

in which v is the number of cubic centimetres of air necessary to restore the initial pressure, J the capacity of the bomb, and p the proportion of hydrogen in the initial gaseous mixture. Hence $\frac{J}{100} \times p \times 1{\cdot}5$ is the maximum concentration corresponding with the disappearance of two volumes of hydrogen and one volume of oxygen.

TABLE I.—*Percentage Combustion of Hydrogen and Air at Atmospheric Pressure.*

Percentage of Hydrogen in the Mixture.	Percentage of Combustion after Ignition by—	
	Spark.	Incandescent Wire.
10·0	98	99
9·5	96	98
9·0	90	95
9·0	89	93
8·75	55	68
8·5	46	62
7·9	34	41
7·5	26	29
7·0	24	29

Table I. shows the percentage of total combustion which was found to occur at atmospheric pressures and with different proportions of hydrogen in the mixture, with both spark and incandescent wire ignition. It will be seen that, except between 9 per cent. and 8·75 per cent. of hydrogen, there is a gradual transition from complete combustion to non-combustibility of the mixture. The figures for ignition by the incandescent wire are throughout rather higher than for spark ignition—partly because more heat is introduced to the gas, but partly also because of the catalytic action of the incandescent platinum.

Some experiments were then made with increased initial pressure. It was found by trial that it was better to prepare the mixture in a gasholder and force it into the bomb rather than introduce the hydrogen and air separately from steel cylinders under pressure. The results of some experiments are shown in Table II.

TABLE II.—*Percentage Combustion of Hydrogen and Air at High Pressures.*

Percentage of Hydrogen in the Mixture.	Initial Pressure, Atmospheres.	Percentage of Combustion.
7·8	2	40
,,	3	31
,,	5	27
,,	10	24
8·9	1	94
,,	2	91
,,	3	57
,,	3	68
,,	3	62
,,	5	42

Though the results of tests made at the same pressure differ appreciably, it is quite clear that the percentage of combustion diminishes as the pressure increases.

* See "JOURNAL," Vol. LXXIX, pp. 632, 702, 1418, 1493.

TABLE III.—*Explosive Limits and Resultant Products of Combustion (Eitner).*

(Volumes Per Cent.)

Gas.	Gaseous Mixture.			Final Products.						Heat Liberated per Litre of Gaseous Mixture.	Maximum Temperature.	Maximum Pressure.
	Gas.	Air.	(Oxygen.)	Oxygen.	Residual Gas.	Nitrogen.	Carbonic Acid.	Water Vapour.	Total.	Calories.	°C.	Atmospheres.
Lower Explosive Limit—												
Carbonic oxide	16·5	83·5	(17·5)	9·2	—	66·0	16·5	—	91·7	498	1860	71·5
Hydrogen	9·5	90·5	(19·0)	14·2	—	71·5	—	9·5	95·2	243	1040	45·8
Methane	6·1	93·9	(19·7)	7·5	—	74·2	6·1	12 2	100·0	565	1970	82·2
Upper Explosive Limit—												
Carbonic oxide	75·0	25·0	(5·3)	—	64·4	19·7	10·6	—	94·7	320	1280	53·9
Hydrogen	66·4	33·6	(7·1)	—	52·2	26 5	—	14·2	92·9	364	1500	60·4

Effect of Pressure.

The chief experiments were limited to pressures between 1 and 10 atmospheres. Eitner's figures for the explosive limits of carbonic oxide, hydrogen, and methane gave the composition shown in Table III. for the mixture at the explosive limit and for the products.

The methane has been omitted at the upper explosive limit because of the subsidiary reactions which occur with it. The heat liberated per litre of the gaseous mixture has been calculated from the calorific power at constant volume, and is given in the table. From Pier's recent determinations of specific heat at constant volume the maximum temperature has been calculated on the assumption that the combustion is explosive or instantaneous, and the maximum pressure has also been calculated from the formula:

$$P\ max. = p \times \frac{T\ max.}{T} \times f$$

in which f is a factor corresponding to the change of the number of molecules in the reaction, and p an initial pressure of 10 atmospheres. The maximum temperature and pressure thus calculated are also given in Table III.

The maximum pressures arising must actually be considerably lower, because the rate of combustion is not instantaneous, but approaches *nil* at the explosion limits. The development of heat in unit time is therefore smaller; and the losses by cooling during the period of combustion become relatively higher. Moreover, it is uncertain what specific heats should be used in calculating the maximum temperature, as the explosion occurs in a closed vessel. Eitner, using the specific heats for constant pressure, found considerably lower explosion temperatures. In any case, the maximum temperatures and pressures must be lower than are shown in the table.

The size of the explosion vessel used—viz., 1940 c.c. capacity, 80 m.m. internal diameter, and 370 m.m. length—was therefore so chosen that the cooling effect of its walls should be as low as possible. A 3-inch wrought-iron gas-pipe was closed with caps at each end; the lower one was soldered to the bomb, the upper one being made tight with sealing wax, so that it could be readily removed. The latter cap carried one pole insulated by vulcanite for ignition; the other pole being on the bomb. It also carried gas inlet and outlet pipes with metal taps, which, when lubricated, were found to be virtually sound at all the pressures employed. The exit pipe served also for taking samples of the gas.

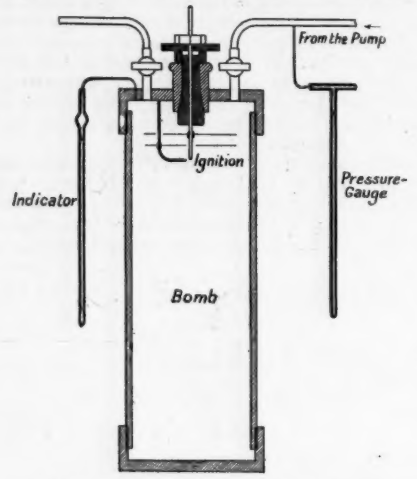


Fig. 1.—Apparatus used in the Experiments.

The arrangement is shown in fig. 1. A modified rotary foot pump was used to give the necessary compression. The pressure-gauge consisted of a volume of air shut off in a glass capillary by a drop of mercury. The gauge was calibrated by determining the points that corresponded with 1, 2, and 10 atmospheres, and interpolating the rest of the scale. A similar arrangement attached by a brass capillary to the lid of the bomb served as a pressure indicator for the explosion. In this indicator the drop of mercury remained in a bulb-shaped enlargement while the bomb was being charged, and was brought into the capillary just before the explosion. Consequently the initial pressure in this gauge was not one atmosphere, but the initial pressure in the bomb. By this arrangement the pressure of the explosion could be much better determined. Both the pressure-gauges were obviously not highly accurate, but had advantages for the object in view.

Spark ignition was used for the principal experiments. Ignition took place 40 m.m. from the side walls and the lid of the bomb. During the experiments the bomb was kept in a bath at 20° C. Having regard to the considerable quantities of the gaseous mixture required for a series of experiments, the gas was stored in most cases in a bell gasholder of 150 litres (about 5·3 cubic feet) capacity. Air and the combustible gas were mixed in about the desired proportions, and then agitated or left to stand overnight before the mixture was analyzed. After analysis the mixture was used as quickly as possible.

As an indication of the rate of change in the mixture, it may be said that a mixture of carbonic oxide and air was found to contain, 14 hours after preparation, 17·91 per cent. of carbonic oxide; and 32 hours after preparation, 17·86 per cent. of carbonic oxide. Control analyses were made on the mixture in the bomb, which showed that, when it was introduced by exhausting the bomb and filling it with the gas twice or thrice, there was no difference between the composition of the gas in the bomb and of that in the holder from which it was filled.

Mixtures of Hydrogen and Air.—Lower Explosive Limit.

Details are given of the methods adopted for the analysis of the combustible mixture and of the final products. The readings were made with a degree of accuracy which rendered the figures in the second decimal place significant; but the percentage of combustion is calculated only to whole numbers. The experiments were made on proportions of hydrogen in the mixture ranging from 8·21 to 10·54 per cent., and with the initial pressures ranging from 1 to 10 atmospheres. It was found that as the pressure increased the explosive limit was raised and the explosive range was reduced, and with mixtures outside the explosive range partial combustion occurred, but became less as the initial pressure was increased.

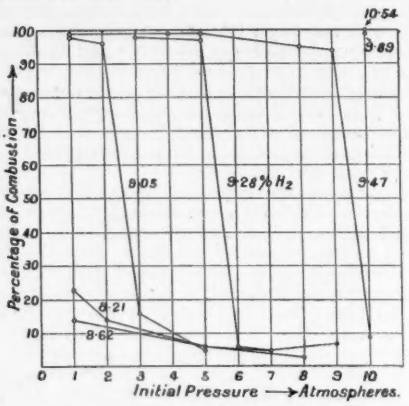


Fig. 2.—Hydrogen, Lower Explosion Limits.

Fig. 2 shows the relation found between the initial pressure in atmospheres (abscissæ) and the combustion expressed as a percentage of the combustible gas originally present in the mixture (ordinates) for different proportions of hydrogen in the mixture. The curves show that in the conditions of the experiments—*i.e.*, with the vessel used and with spark ignition near the top—a tolerably sharply defined explosion limit is found. Either almost complete combustion—viz., over 94 per cent.—or only very slight partial combustion—viz., less than 23 per cent.—occurs. Intermediate values are wanting. Between 2 and 3 atmospheres the explosive limit is 9·05 per cent.; between 5 and 6 atmospheres, 9·28 per cent., and between 9 and 10 atmospheres, 9·47 per cent. That is to say, with the lower of the two pressures named explosion occurs, but not with the higher pressure.

As regards partial combustion, the results show a want of uniformity, which may in part be attributed to small differences in ignition, and in part to the partial combustion at the first ignition being limited to the hydrogen in the immediate vicinity of the spark and extending on a second ignition, after diffusion has occurred, to hydrogen which was not at first in the vicinity of the spark. Moreover, just above the explosive limit combustion is not complete. Probably a portion of the hydrogen does not burn owing to the cooling effect of the walls of the vessel; and this effect is greater the closer the mixture is to the explosive limit, since the development of heat is then at its lowest.

(To be continued.)

Yorkshire Junior Gas Association.—A meeting of the Association will be held at Bradford next Saturday, when, by permission of Mr. Charles Wood (the Gas Engineer and Manager), the members will be afforded an opportunity of inspecting the new Darley Street show-rooms of the Gas Department. The inspection will be followed by a paper on "Coke Sales," by Mr. Charles Roper.

Power Production from Gas-Engines.—In the course of a lecture delivered before the Rotherham Engineering Society by Mr. A. Vennell Coster, of Messrs. Crossley Bros., he emphasized the advantages of the gas-engine owing to its capability of utilizing waste fuels and gas for the production of power. He pointed out that, under working conditions, the following consumptions have been obtained with gas-engines and producers per brake-horse-power-hour: Coke breeze and charcoal, 1 lb.; peat briquettes, 1·25 lbs.; lignite, 1·75 lbs.; cotton seed, 2·5 lbs.; peat, 3·3 lbs.; and bark refuse containing up to 50 per cent. of moisture, 4 lbs. But the thermal advantages of the gas-engine are, he said, not confined to the utilization of waste products. With all ordinary grades of coal and coke, if the calorific value of the fuel as supplied to the boiler or producer is taken as 100, then 25·8 per cent. of the heat is converted into useful work in the gas-engine, as against 13 per cent. in the steam-engine; so that with engines working at from three-quarters to full load the thermal efficiency of the former is about twice that of the latter.

SEPARATION OF THE ILLUMINANTS IN MIXED COAL AND WATER GAS.

At the last annual meeting of the American Gas Institute, a paper on this subject was submitted by Messrs. G. A. BURRELL and I. W. ROBERTSON, of the United States Bureau of Mines. The following are the principal portions of it.

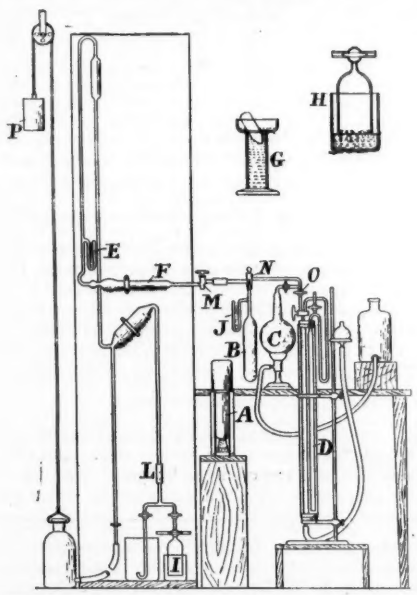
INTRODUCTION.

In this paper are shown experiments made by the Bureau of Mines which resulted in separating the illuminants in the artificial gas of Pittsburgh, made by mixing one part of carburetted water gas with three parts of coal gas. The separation was made by fractionally distilling the gas in a vacuum at low temperatures, and follows the method detailed by the Bureau in separating natural gases.* In the case of both the natural gas and the coal gas, advantage was taken of work on the subject by MM. Lebeau and Damiens, who separated mixtures of the paraffin hydrocarbons and coal gas by the same method.† The Bureau, however, separated the paraffin hydrocarbons into single constituents, and found it necessary to refractionate distillates and residues in all cases to obtain pure gases. MM. Lebeau and Damiens do not mention this latter necessity, and they separated the paraffins in pairs. Further, there is shown in the paper a simple method for the determination of benzene in artificial gas. The principle of the procedure rests on the fact that the gases at different stages in the analysis are subjected to temperatures at which certain constituents can be removed by a mercury pump from certain others which have low vapour tensions at the temperature selected. It was found impossible to make a clean separation in any case at one fractionation; hence distillates and residues were refractionated until the separation was as complete as desired.

The following is the composition of the coal gas of Pittsburgh as analyzed by the ordinary method:

Constituents.	Per Cent.
Carbon dioxide	2·64
Oxygen	0·81
Illuminants	8·67
Carbon monoxide	13·34
Hydrogen	37·04
Methane	30 96
Ethane	1·82
Nitrogen	4·72
Total	100·00

In making the analysis, the carbon dioxide was removed by caustic potash solution, the oxygen by alkaline pyrogallate solution, the illuminants by fuming sulphuric acid, the hydrogen by absorption in colloidal palladium solution, the methane and ethane by slow combustion, and the nitrogen by difference.



Apparatus for the Liquefaction and Fractionation of Gases.

The gas was next subjected to fractional distillation at various low temperatures, in the apparatus shown in the accompanying diagram. A is a Dewar flask to hold the refrigerant used in cooling the gases; B the bulb in which the gases were cooled; D a gas analysis burette; C a container for measuring the gases prior to cooling; E a gauge for registering pressures in the Töpler pump; F a drying-tube containing phosphorous pentoxide for removing the water vapour from the gases. G, H, and I are containers for trapping the gases over mercury as they were removed from the pump; H and I being provided with three-way stopcocks. The particular advantage of containers such as H and I lies in the fact that they could be filled with mercury by forcing-down on them with the stopcock open to the air, finally filling the capillary tubes with mercury. The gas from the pump could then be introduced into them by the goose-neck tube attached to L, leaving a mercury seal in the capillary tube. J is a pressure-gauge which was of most use in the benzene determination. M, N, and O are three-way stopcocks. A counterpoise P attached to the mercury reservoir of the Töpler pump facilitated its working.

* See "JOURNAL," Vol. CXXVII., p. 220.

† *Ibid.*, Vol. CXXII., p. 105.

FIRST SERIES OF FRACTIONATIONS.

The original volume of the sample (2048 c.c.) was freed from carbon dioxide by passing it through a caustic potash solution; 53 c.c. were removed, leaving 1995 c.c. The latter was then cooled in the bulb B (about 300 c.c. at a time) at the temperature of liquid air. After the introduction of each 300 c.c., pumping was started, and as much of the gas removed as possible. There resulted a distillate I. and residue II. The distillate was fractionated at the temperature of liquid air, resulting in fractions III. and IV.; the latter was added to the residue II. and the total again fractionated at the temperature of liquid air. A distillate VI. thus obtained was added to the distillate III., and the total again fractionated at the temperature of liquid air. The residue thus obtained (10 c.c.) was added to the residue V., and the total again fractionated. There resulted a distillate VII. of 3 c.c., which was added to the distillate IX., making a total of 1782 c.c. The first series of fractionations shows the general procedure. At the temperature adopted—in this case that of liquid air—the gases were repeatedly fractionated until no more distillate of consequence could be obtained. The final distillate obtained (3 c.c.) is only about 0·15 per cent. of the original quantity of gas. The total distillate obtained was 1782 c.c., and it consisted of those gases which have an appreciable vapour tension at that temperature. It consisted of 0·81 per cent. of oxygen, 13·25 per cent. of carbon monoxide, 37·33 per cent. of hydrogen, 31·13 per cent. of methane, and 4·23 per cent. of nitrogen. It will be observed that the quantities of these constituents check very well with the quantities of the same constituents found in the original ordinary analysis of the coal gas. The residue of the first series of fractionations (191·6 c.c.) should consist of the gases and vapours that do not have an appreciable vapour pressure at the temperature of liquid air. They are C_2H_6, C_3H_8, C_4H_{10}, C_2H_4, C_3H_8, C_4H_8, and C_6H_6; in other words, the so-called illuminants of coal gas, with the addition of ethane and probably propane.

SECOND SERIES OF FRACTIONATIONS.

The residue VIII. (191·6 c.c.) was next cooled at temperatures of from 155° to 145° C., and as much gas removed as possible with the mercury pump. Distillates and residues were repeatedly fractionated until there was obtained 167 c.c. of gas consisting of ethane and ethylene. This fraction was analyzed in two ways, by burning the entire fraction with oxygen, and by removing the ethylene with fuming sulphuric acid, and then burning the ethane in oxygen. The following are the data covering these two methods:—

Analysis by Combustion.

	Cub. C.
Sample taken	15·12
Oxygen added	94·42
Total volume	109·54
Volume after burning	78·00
Contraction produced	31·54
Volume after KOH absorption	48·27
Carbon dioxide produced	29·73
	Per Cent.
Ethane	23·90
Ethylene	74·40

Analysis by Absorption and Combustion.

	Cub. C.
Sample taken	34·18
After absorption in fusing H_2SO_4	8·85
Absorbed by fuming H_2SO_4	25·33
Oxygen added	76·28
Total volume for combustion	85·13
Volume after burning	64·95
Contraction	20·18
Volume of KOH absorption	49·02
Carbon dioxide produced by burning	15·93
	Per Cent.
Ethane	23·3
Ethylene	74·1

It will be observed that the ethane and ethylene by the two methods check very well; showing that other gases were not present in significant amounts. The percentages found as above were averaged and calculated to percentages of the original gas.

THIRD SERIES OF FRACTIONATIONS.

After the removal of the ethane and ethylene, there remained 24·4 c.c. of gas, which was fractionated at temperatures ranging from 130° to 120° C. The distillate (21·1 c.c.) was analyzed by burning in oxygen and measuring the resulting contraction and carbon dioxide, and calculating to propane and propylene. This method does not isolate the gases, and hence does not show that other gases than these two were not present. In working on the separation of the paraffin hydrocarbons, however, the Bureau found that propane could be separated from ethane at temperatures between 130° and 120° C. Propylene has a boiling-point

close to propane, and that of ethylene is not far different from that of ethane. Hence it is assumed propylene and ethylene would respond to the same treatment as the propane and ethane.

Fourth Series of Fractionations.

After removing the propylene and propane, there remained a residue of 2·3 c.c., or only 0·11 per cent. of the original 2048 c.c. This residue was analyzed by burning in oxygen, and the contraction and carbon dioxide calculated to butylene. The observed data are as follows :—

Analysis of Butylene Residue.

	Cub. C.
Volume taken for analysis	2·30
Oxygen added	93·81
Total volume	96·11
Volume after burning	90·53
Contraction produced	5·58
Volume after KOH absorption	82 86
Carbon dioxide produced by burning	7·67

According to the reaction

$$C_4H_8 + 6O_2 = 4CO_2 + 4H_2O$$

there result three volumes contraction and four volumes carbon dioxide, when butylene reacts with oxygen. The contraction and the carbon dioxide produced in the above analysis—5·58 c.c. and 7·67 c.c.—are almost in the ratio of 3 : 4, within the error of making the analysis; hence the data were calculated to butylene. Such a small quantity of gas was available to work upon that there might easily have been a trace of butane present. However, the total quantity compared with the original volume was only 0·11 per cent., or practically insignificant.

The total number of cubic centimetres of gas from the various fractions equals 1782 + 167 + 21·1 + 2·3 = 1972·4 c.c., exclusive of the benzene. The benzene as found by using a separate portion of the gas is 1·33 per cent. of the gas. Then 2048 c.c. × 1·33 per cent. = 27·2 c.c.; and 1972·4 c.c. + 27·2 c.c. = 1999·6 c.c., or within about 5 c.c. of the amount (1995 c.c.) that was fractionated. Considering the number of times the different fractions of gas were handled and measured in the fractionation analysis, this is not a bad check on the operation.

Determination of Benzene.

For the benzene determination a separate quantity of gas was used, and advantage was taken of an apparatus suggested by Dr. Hulett, the Chief Chemist of the Bureau, for the determination of water vapour in air. He suggested that air with its moisture should be cooled at the temperature of liquid carbon dioxide, the air then removed with a mercury pump, and the water vapour determined after removing the cooling medium, by measuring its pressure. It was a simple matter to apply this principle to the determination of benzene in coal gas. The procedure was to free the gas of carbon dioxide and water vapour, and introduce it into the liquefaction bulb B, cool it at a temperature of 78° C., and remove as much gas as possible with the pump. The stop-cock N on the bulb was then closed, and the Dewar flask containing the cooling medium removed. The condensed liquid in the bulb was then vaporized, and its pressure read on the manometer J. This pressure compared with the original pressure of the gas gave the percentage of benzene in the coal gas. The results of two determinations are given below:

Original Pressure of the Gas. Mm. of Mercury.	Partial Pressure of the Benzene Vapour. Mm. of Mercury.	Illuminants Found in the Distillate. Percentage of the Total Coal Gas.	Calculation of Benzene.	Percentage of Benzene in the Mixed Gas of Pittsburgh.
744	10	7·32	$\frac{10 \times 100}{744}$	1·34
744	9	7·39	$\frac{9 \times 100}{744}$	1·31

The total illuminants in the mixed gas of Pittsburgh, as found by absorption in fuming sulphuric acid, is 8·67 per cent. The distillate from the benzene determination was analyzed by absorbing the remaining illuminants in fuming sulphuric acid; and there was removed 7·32 and 7·39 per cent. of the distillates. These amounts, when added to the benzene found—1·34 and 1·31 per cent.—equal 8·66 and 8·70 per cent., or almost identical with those of the total illuminants in the mixed gas. Benzene reacts with oxygen as follows:

$$C_6H_6 + 7{\cdot}5\ O_2 = 6CO_2 + 3H_2O.$$

The contraction is 2·5 volumes, and the carbon dioxide is 6 volumes.

The following data show the results of analysis of the residual vapour held in the liquefaction bulb when the gas was cooled at a temperature of 78° C. Before analysis the benzene vapour was diluted with air:

	Cub. C.
Volume taken for analysis	28·29
Oxygen added	51·94
Total volume	80·23
Volume after burning	75·47
Contraction due to burning	4·76
Volume after KOH absorption	64·25
Carbon dioxide produced by burning	11·42

It will be observed that the ratio between the carbon dioxide and contraction is almost exactly 6 : 2·5; showing that the vapour obtained in the determination was benzene. Traces of other easily condensable vapours may have been present, but apparently in such small quantity as to be negligible. The authors were unable to find the vapour pressure of benzene at 78°C.; but apparently it is very small—benzene boiling at 80° C. At 20° C., the tension is 5·76 mm. The authors prepared saturated vapours of benzene by shaking pure benzene with dry air. It was a simple matter to prepare unsaturated vapours of benzene by simply diluting the saturated vapours with air. The quantity of benzene in the air was checked by combustion analysis. A number of tests were made of the benzene in air by the method described; and it was found that at 78° C. all the benzene could be separated from the air. Analyses were made of the distillates and residues, to make sure that all the benzene remained in the liquefaction bulb at 78° C.

The foregoing method, therefore, seems to be well adapted for the benzene determination. There is needed a mercury pump, a liquefaction bulb, a gas burette for introducing the gases, and a Dewar flask for holding the refrigerant. A temperature of 78° C. can easily be obtained by using the liquid carbonic acid sold in tanks. The original volume of gas has not even to be measured and its exact value determined. It is sufficient to introduce it into the liquefaction bulb at atmospheric pressure, and then to read the barometer.

Complete Analysis of the Mixed Gas.

The complete analysis of the gas by the foregoing methods follows:

Constituent.	Per Cent.	Constituent.	Per Cent.
Carbon dioxide	2 63	Propane	0·35
Oxygen	0·80	Ethylene	6·05
Carbon monoxide	13·25	Propylene	0·60
Hydrogen	37·33	Butylene	0·11
Methane	31·13	Benzene	1·33
Ethane	2·10	Nitrogen	4·32

There is shown below the analysis of a sample of the mixed gas collected on a different date. It is interesting as showing the marked uniformity of the gas as collected on two days about seven weeks apart. The benzene was not determined, as the method had not been perfected.

Constituent.	Per Cent.	Constituent.	Per Cent.
Carbon dioxide	2 40	Ethane	1·92
Oxygen	0·61	Propane	0 32
Carbon monoxide	13·63	Ethylene	6 36
Hydrogen	37·13	Propylene	0·70
Methane	30·92	Butylene	0·12

Heating Value of the Illuminants in the Mixed Gas.

In calculating the heating value of mixed gas from the analysis as ordinarily made, a value is usually assigned to the illuminants which is an approximation, because their constituents are not exactly known. With these data at hand for the Pittsburgh gas, the authors give a value calculated from the complete analysis:

Constituents.	B.Th.U. per Cubic Foot at 0° C. and 760 Mm.*	Constituents in the Gas.	Heating Value of the Constituents.
Ethylene	1673	0·0605	101·21
Propylene	2509	0·0060	15·05
Butylene	3265	0·0011	3·59
Benzene	4012	0·0133	53·36
Propane	2654	0·0035	9·29
		0·0844	182·50

* The heating values were calculated from those given by Thomsen, and contained in Landolt and Börnstein's "Physikalisch-Chemische Tabellen" (1905), p. 425.

According to the above calculations, the illuminants have a heating value at 0° C. and 760 mm. of $\frac{182{\cdot}50 \times 100}{8{\cdot}44} = 2162$ B.Th.U. The authors have included propane in the illuminants as ordinarily determined by absorption in fuming sulphuric acid, because it dissolves to a certain extent in the acid; but just how much is not known. It was found that the methane and ethane were soluble to a slight extent. Unquestionably propane is much more so, because the higher paraffins are more soluble than the lower ones. Excluding propane, the heating value of the illuminants becomes $\frac{173{\cdot}2 \times 100}{8{\cdot}09} = 2141$ B.Th.U. per cubic foot.

Future work on the fractionation of artificial illuminating gas will cover the analysis of gas used in other cities, and the separation of the illuminants in the coal gas before it is mixed with carburetted water gas, and in oil gas used to enrich water gas.

The Second "Hawksley Lecture."—In accordance with the arrangements made by the Council of the Institution of Mechanical Engineers, Mr. B. W. Bryan, M.Inst.C.E., delivered on the 4th inst. the lecture mentioned above, which had been prepared by his late father, on "Pumping and Other Machinery for Water-Works and Drainage." The author began by describing an early type of pumping plant at Philadelphia and the rotative beam and other engines at Bow, and then dealt successively with Cornish, beam, horizontal, and triple-expansion engines. Steam turbo-pumps were described, and particulars given of a large installation at Petrograd. This portion of the subject closed with references to the Humphrey pumps at Chingford, and the "air-lift" system of raising water. In connection with pumps for drainage purposes, a description was given of what the author believed to be the largest and most interesting installation in existence—viz., that at New Orleans. As already mentioned in the "Journal," arrangements were made for the repetition of the lecture in Manchester and Birmingham last week.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The War and Capital Raising by Statutory Gas Companies.

SIR,—Messrs. R. W. Cooper and Sons, in their letter to you published in the last issue of the "JOURNAL," suggest that in my communication of the 27th ult. I have misstated the proportion of loan capital permitted by the "Model Clauses." But, as you have been good enough, in your note on the question appearing on p. 522, to point out to Messrs. Cooper that they have misread my letter, I need not refer further to this aspect of the case.

Had the proportion been as stated by Messrs. Cooper, it would inevitably have made a difference to the suggestion I made, as it would have altered the relative proportion of the security available for the mortgagee. The capital basis, however, is not the one upon which a mortgagee would base his considerations of such an issue. He would rather look at the earning capacity of the concern, and determine how many times the interest on the mortgage is covered by the normal profits made.

In this respect, I may point out that the provisions of the "Model Clauses," in their simplicity (taking a 5 per cent. basis for ordinary capital and a 4 per cent. basis for loan stock), permit of the raising of a profit four-and-three quarter times as much as the loan capital demands in interest—a margin of safety which few mortgagees are able to obtain. It was for these reasons that it occurred to me to suggest that the margin of safety or cover might be very considerably reduced without impairing the security of the present loan capital or that of the ordinary stock. On the contrary, it can be shown that by doing so the ordinary shareholder, or preference interests, would be the better served.

It may be interesting to inquire what are the facts of the past relating to gas company finance in this respect. If we take the companies enumerated in "Field's Analysis," it will be found that, on the average, the loan interest is covered eight times in the amount of gross profit earned; and that only six out of the twenty companies enumerated approach anywhere near the provisions of the "Model Clauses." There is one company whose profits cover the loan interest by forty-seven times, another by twenty-seven times, and several by from ten to twelve times. On the other hand, there are two large companies, whose gross profits do not reach the four-and-three quarter times' ratio which the proportion in the "Model Clauses" allows.

Thus, while there are a few companies who would require to get an extension of powers to increase the proportion at present permitted by the "Model Clauses," the vast majority of the companies can greatly increase their capital by applying only for powers now commonly conceded, and as enumerated in the "Model Bill."

From Messrs. Cooper's letter I gather that they approach this question from a different point of view to that assumed by myself. They seem to have the ordinary shareholder primarily in view; whereas, rightly or wrongly, I am in the habit of looking at the gas industry from the consumers' point of view, rather than from the shareholders' point of view. But, as the interests of both parties are so closely interwoven, it is a question whether it is possible to benefit the one without benefiting the other; and, while I admit that my proposal would bring about a cessation of the issue of ordinary gas companies stock, it will be difficult to prove that this would injure the present holders. On the contrary, I am prepared to show that it would improve their position. Therefore, if a cheaper method of financing gas companies can be disclosed than by the issue of ordinary stock even on a 5 per cent. basis, then in my view it is in the interests of all parties that it should be done.

The figures I have given are, from my point of view, sufficient to justify a much larger proportion of: (*a*) Loan capital than is at present in existence in the case of most gas companies. (*b*) Even larger than the "Model Clauses" permit.

In my opinion, if the normal profits of a statutory gas company are sufficient to cover mortgage interest three times, then the mortgagee has ample security, and the effect would be that the loan capital would approximate to two-thirds of the ordinery capital and be equal to 38·46 per cent. of the whole. It does appear from the statistical records of the industry that in the past preference has always been shown to the issue of ordinary capital stock, as is illustrated by the figures already given as to the small proportion of the gross profits now required to pay interest on loan capital.

If the circumstances are such as are indicated in my former letter, and with which Messrs. Cooper appear to agree—that gas stock cannot be issued on the basis contemplated in the "Model Bill," viz., as a 5 per cent. stock—then certainly some provision must be made to raise such capital without inflicting permanent injury on the industry and the consumer.

Whether this is best done by the intervention of Parliament (granting some special provisions) or by the means I have indicated, is a matter that is worthy of careful consideration. But, as already stated, looking at it from the public point of view, there is much to be said in favour of extending the borrowing powers of gas companies, and in the cessation of the issue of ordinary stock until such times—probably far ahead—when the financial world has assumed its normal conditions after the eruption of the present war.

W. R. HERRING.

Palace Chambers, Westminster, S.W.,
Dec. 9, 1914.

Weighing Attachments on Retort-Charging Machines.

SIR,—As against the theoretical opinion of Mr. Broadhead with regard to the above, may we record the fact that eighteen machines of the type under discussion have been made by us?

Engineers, before adopting any particular type of machine, generally take the precaution to obtain the opinion of those who have already installed similar plant, and further make a thorough inspection under actual working conditions.

The number of machines supplied is, in our opinion, sufficient proof to the gas industry that the claims suggested in your "Editorial" are warranted and borne out in actual practice, and such advantages are obtainable with the machine which we are proud to associate with our name.

per pro W. J. JENKINS AND CO., LTD.
W. S. SMART, General Manager.

Retford, Dec. 11, 1914.

Supply of Water for Troops.

SIR,—In reference to "Subscriber's" inquiry in your last issue. In the circumstances mentioned, I would suggest that the private houses become *pro tem.* "boarding houses." Consequently, they would come under the decided case *Pidgeon v. Great Yarmouth Water-Works Company*; so that no additional water-rate can be levied.

WATER-WORKS.

Dec. 12, 1914.

REGISTER OF PATENTS.

Manufacture of Fire-Clay Gas-Retorts.

EVERS, G. V. (E. J. & J. Pearson, Limited), of Stourbridge.

No. 25,590; Nov. 8, 1913.

This invention relates to the manufacture of fire-clay gas-retorts and other like bodies produced from plastic refractory materials.

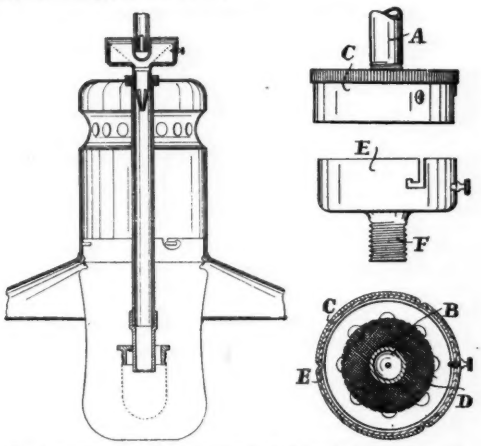
Ordinarily the manufacture of such retorts, the patentee remarks, involves the handling of the articles between the shaping and the firing operations; in the case of large articles the cost of handling is a considerable item in the total cost of manufacture. The object of his invention, therefore, is to eliminate the handling, and "thereby not only lessen the expense of production, but also diminish the risk of loss by breakage." It comprises the shaping and firing operations in one and the same position, and the employment of a kiln with a removable top or side and a travelling shaping machine which can move relatively to the kiln and is adapted to deposit the shaped articles in the required positions within the kiln.

Gas-Burners.

BLAND LIGHT SYNDICATE, LIMITED, and GOULD, F. J., of Little Trinity Lane, E.C.

No. 25,815; Nov. 11, 1913.

This invention relates to an inverted incandescent gas-burner, the two main portions of which are attached by bayonet joints; "the burner being designed for both high and low pressure lighting for use in factories, workshops, and the like."



Gould's (Bland Light Syndicate) Inverted Gas-Burner.

The burner comprises two main portions, one having a depression to receive the gas inlet pipe and the other a tubular extension adapted to receive a shade or shade support. The air for the gaseous mixture enters the mixing chamber through orifices in the under part of the lower portion of the burner, and the tubular extension of this portion is threaded to receive locking nuts securing the shade support to the burner.

The gas inlet A is screw-threaded to engage a threaded depression or inverted dome B in the cap part C of the mixing-chamber D, the under side of which is formed by the cup-like part E, which has a threaded tubular extension F and is provided with air-inlet orifices J. This extension receives the locking nuts which secure the shade support and the burner pipe.

Incandescent Gas-Fires.

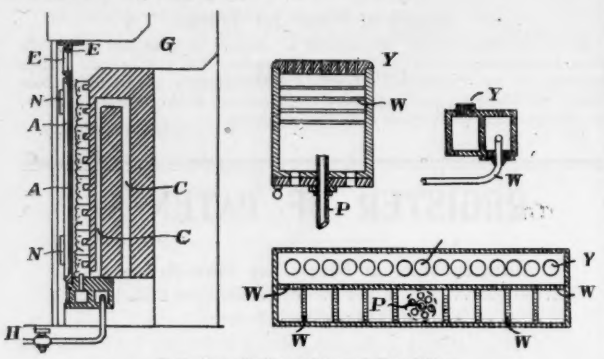
ARMSTRONG, J., of Victoria Street, S.W.

No. 25,934; Nov. 12, 1913.

This invention is "characterized by having an atmospheric burner somewhat different from those in general use in gas-fires, by the fact that it is so constructed as to be incapable of mixing gas and air in the ordinary way." This gas may be at atmospheric pressure, and both it and the primary and secondary air are induced through the apparatus by the partial vacuum caused by the chimney draught. For this purpose the apparatus must be enclosed.

The patentee says he is aware that gas-fires have been enclosed and connected with the usual chimney flue of a room, and he claims no novelty in this enclosure; but he does not use the enclosure for the same purpose. It is used for inducing a mixture of the gas and primary air through a mixing chamber, in which are inserted a series of

perforated plates or screens, or such like (W on the illustration), and which enable him "to make a more intimate mixture of air and gas than is possible by means of the gas pressure injector principle of the ordinary atmospheric burner, so that this highly ignitable mixture can be drawn through fine perforations in the top of the burner Y. The perforations, being of small dimensions, abstract the heat from the flame and prevent it igniting back."



Armstrong's Incandescent Gas-Fire.

The enclosure A is made to open on hinges N, for the purpose of access to the burners. It is made of any fire-resisting material, either transparent or otherwise; but it is preferred to use transparent or semi-transparent diathermanous substance. The top portion is also made to open separately at E for the purpose of regulating the draught to the chimney G. The gas is conveyed to the mixing chamber by the pipe H. The air supply is regulated by the perforated bottom X revolving round the pipe P.

The back of the fire (of fire-resisting material) is constructed with tubes or channels C, through which the secondary air is also drawn by the suction of the chimney draught. This secondary air may also be regulated by means of a damper. As the primary air is mixed in the first instance to a very high extent, the secondary air required will, it is said, be very small. "It will therefore be possible to convey it through fine channels or tubes, which will attain a very high temperature—thus augmenting the temperature of the gas-flame." The gas-flame heats to a high temperature the back as well as the fire-clay or asbestos tubes or blocks or balls placed in front of it.

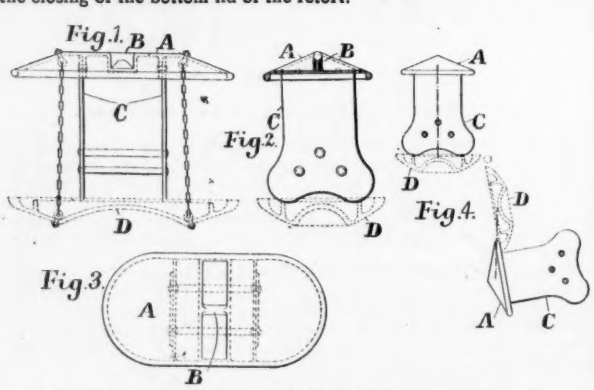
Vertical Gas-Retorts.

ROBERT DEMPSTER AND SONS, LIMITED, of Elland, and BROCKWAY, F. G., of Cleethorpes.

No. 1997; Jan. 26, 1914.

The object of this invention is to provide a stop or table to support the lower face of the charge in an intermittent vertical gas-retort without interfering with the free discharge of the coke therefrom, and without necessitating the detachment of the bottom lid.

For this purpose a table flexibly connected with the bottom lid is used in such a manner that when the lid (which is hinged to the mouthpiece) is opened, the table falls clear of the descending coke. After the coke has been discharged, a long chain is let down through the retort until an attachment at its lower end is in a position to engage an attachment on the table—either automatically or by the use of a suitable rod or tool. The table can then be drawn up into position within the lower portion of the retort or retort mouthpiece, and is held by the closing of the bottom lid of the retort.



Dempster and Brockway's Vertical Retort Discharging Stop.

Fig. 1 is a side elevation, fig. 2 a central vertical section, and fig. 3 a plan of the table in its operative position—resting on the ordinary self-sealing lid of the bottom mouthpiece of the retort—indicated by dotted lines in figs. 1 and 2. Fig. 4 shows the table withdrawn from the retort mouthpiece and suspended from the lid by chains—that is, in the discharging position.

A is the top of the table; B, the eye for receiving the hook or catch on the chain let down through the retort; C, the legs or supports of the table resting on the lid D, to which the table is also secured by chains. Assuming the lid to be hinged at its broad side (represented at the right-hand side in fig. 2), when the lid is opened, withdrawing support from the legs, the chains pull the table down, so that it will turn over at right angles and drop into the position shown in fig. 4—that is, with the legs hanging out of the path of the falling coke.

Dry Gas-Meter Mechanism.

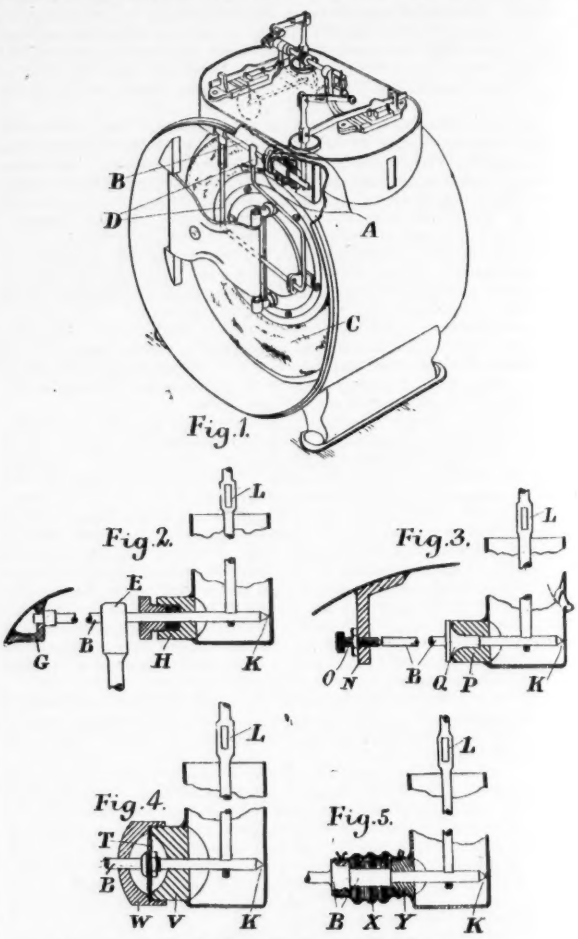
THORP, FRANKLIN, of Whitefield, near Manchester.

No. 27,082; Nov. 25, 1913.

This invention relates to the method of transmitting the movements of the diaphragms of dry gas-meters to the valves and recording motion employed.

All dry gas-meters, the patentee remarks, have the measuring chambers in which the diaphragms move separated from the chamber containing the valves by a partition, and no gas should be able to pass from one chamber to the other except by means of the valve openings. It has been customary to convey the motion of the measuring diaphragms to the valves by rods passing through stuffing-boxes; the reciprocating motion of the diaphragm being converted by the flag arm into an angular motion on the rod passing through the stuffing-box. This angular motion is then converted to a circular rotatory motion by means of links. Again, the circular motion is converted by means of a crank so as to give the slide-valves a reciprocating motion. The arrangement described "is almost universally employed, but possesses many disadvantages due to the necessity of converting various motions from one form to another."

It has been proposed, he says, to overcome the difficulty by directly transmitting the reciprocating motion of the measuring diaphragms to the valves by means of a rocking lever. Patent No. 15,255 of 1913 described a meter of this type, and claimed, among other things, "a



Thorp's Dry Gas-Meter Mechanism.

flexible and impermeable diaphragm dividing the valve chamber from the main diaphragm chamber." Other devices have also been used in water and other fluid meters for separating the valve chamber from the measuring chamber.

The present invention consists in employing the devices he describes in combination with a rocking lever, which displaces the lever described in patent No. 15,255 of 1913. It consists of a rocking lever cranked at the position of the pivot; the horizontal portion of the lever crank being therefore in place of, and in the position of, the pivot. This horizontal shaft will have an angular movement, and acts as the pivot of the rocking lever.

Fig. 1 is a diagrammatic view of the meter mechanism. Figs. 2, 3, 4, and 5 show detailed sections of the various devices referred to.

In fig. 1 A refers to the gas-tight joint and transmitting mechanism and to its general arrangement in the meter; the particular device used for purposes of illustration being that detailed in fig. 5. B is a central shaft common to all the devices to be described. C is one of the two diaphragms by means of which the meter records the quantity of gas passing through it in a manner explained in patent No. 15,255 of 1913. D is a stirrup rigidly secured at its upper ends to the shaft B, and attached at its lower end, by bearings in which it can freely move, to the diaphragm C. The parts B D form the improved locking lever referred to.

To make a gas-tight connection between the main diaphragm chamber and the valve chamber one of four methods described and illustrated

are employed. B is the central shaft common to each device. L is a vertical rod (common to each device) which operates the slide-valves and recording mechanism in a manner described in the earlier patent. K is the pivoted end of the central shaft B.

In fig. 2, E is the upper extremity of the stirrup D. [This is not shown in figs. 3, 4, or 5, but is understood to be present in the systems described.] G shows one form of bearing for one end of the shaft B; the bearing being secured to the body of the meter. This form of bearing may be employed with any of the devices described. H is a stuffing box of a design in general use; the female part being secured to the tubular portion of the partition between the main diaphragm chamber and the valve chamber—a gas-tight joint being obtained by packing placed in the stuffing-box. The length from the point of the pivot to the collar on the other extremity of the shaft is such as to prevent end-play of the shaft.

In fig. 3, N is a bracket secured to the body of the meter. O is an adjusting screw forming an end bearing for one end of the shaft B and maintaining the latter in any desired position. P is the female portion of a gas-tight joint secured to the tubular portion of the partition separating the two chambers already mentioned. Q is the male component of the joint. The two components are so designed that the surfaces in contact, which make the joint, are in the form of a tractrix curve—a joint being thus produced which has the property of being gas tight. Further, its form effectively prevents any wedging action taking place. In this particular case the pivot K is not in actual contact with the tubular portion of the partition between the two chambers previously mentioned.

In fig. 4, T is a flexible gas-tight diaphragm secured in a vertical plane at right angles to the axis of the shaft, by a nut tightening against a shoulder on the shaft. V and W are the members of a support for the vertical diaphragm T, W screwing on to V, and gripping the periphery of the diaphragm—thus making a gas-tight joint between the chambers.

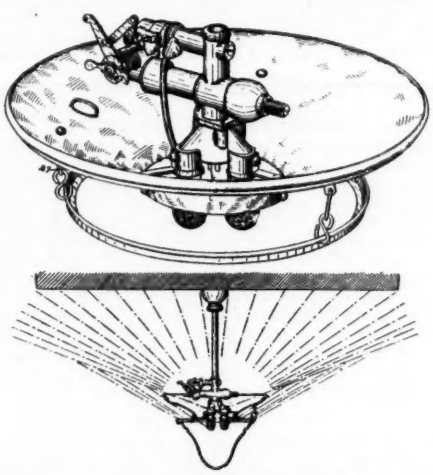
In fig. 5, V is a flexible gas-tight cylindrical sleeve corrugated along its length secured circumferentially at its one end to the shaft B and at its other end to the bearing piece Y, which is secured to the tubular portion of the dividing partition, and forms a bearing for the shaft—a gas-tight joint being thus produced between the two chambers.

Gas-Lamps.

THOMPSON, W. P.; a communication from ALFRED H. HUMPHREY, of New York City.

No. 27,790; Dec. 3, 1913.

This invention is more particularly described in the patent specification with reference to a gas-lamp of the indirect type or semi-indirect type—that is to say, lamps in which the light is directed upwardly.



Humphrey's "Indirect Lighting" Gas-Lamp.

According to the proposal of the patentee, a casing is provided open at its top and bottom and entirely supported by arms projecting from the burner in such a manner that it is illuminated on both its sides by light from the burner. The casing is supported by the burner with its upper edge substantially in the plane of the mixing-tube arm and beyond the outer end of it; the lower end of the casing being preferably in approximately the plane of the burner tip, so that there is a substantial space between all parts of the burner and casing. A globe, open at the upper end, is suspended from the casing with its upper edge in approximately the plane of the lower end of the casing member; the diameter of the upper end of the globe being preferably substantially greater than the diameter of the lower end of the casing, so that there is a substantial space between the globe and casing above whereby light can radiate from the burner through the casing and also between the globe and the casing, and light may also be reflected from the inside of the casing and from the inside of the globe through the casing and between the globe and the casing.

Ballarat Gas Company.—The accounts for the half year ended July 31, which were submitted to the shareholders at the recent meeting, showed that the amount standing at the credit of the profit and loss account was £8938. This the Directors proposed should be dealt with as follows: To reserve fund, £1000; write-off meter account, £500; payment of a dividend of 5 per cent. and a bonus of 1 per cent., £4050; carrying forward £3388.

LEGAL INTELLIGENCE.

THE SOUTH METROPOLITAN GAS COMPANY AND ILLEGAL CHARGES BY THE SOUTH LONDON ELECTRIC SUPPLY CORPORATION.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

(*Before Mr. Justice* EVE.)

Friday, Dec. 11.

Attorney-General (At the Relation of the South Metropolitan Gas Company) v. South London Electric Supply Corporation.

Mr. MARK ROMER, K.C. (with him Mr. MAUGHAM, K.C., and Mr. PERCY WHEELER), said he had to move under the provisions of Order 32, Rule 6, for judgment in this action in consequence of admissions in the defence. The action was brought for the purpose of restraining defendants from committing a breach of sections 19 and 20 of the Electric Lighting Act, 1882, which prohibited electric companies from granting an undue preference to one customer over another. The defendants were proposing to grant to customers a rebate of ½d. per unit for electric light on condition that the customers would agree to light their premises only by means of electricity. In an area in which a gas company was a rival, the object of the circular was apparent. Indeed, it was very similar to the circular which Mr. Justice Sargant held to be illegal in the Long Eaton case. When the present action was started, Mr. Justice Sargant had given his decision, but it was under appeal; and before the defence was delivered, the appeal had been dismissed with costs. The defendants now no longer desired to contest the claim. The Long Eaton case was a rather complicated one, as there was another preference which was challenged; and Mr. Justice Sargant considered the particular preference, and found that it could not be justified. Having read sections 19 and 20, the learned Counsel said section 20 referred to undue preference and section 19 showed what the undue preference consisted of.

Mr. TYLDESLEY JONES, for the defendants, said he did not attempt to justify the circular, having regard to the decision of the Court of Appeal; and he submitted in the defence to a declaration. The only question was whether the plaintiffs were entitled to have an injunction as well.

Mr. Justice EVE: Would not "liberty to apply" meet the case?

Mr. TYLDESLEY JONES said he did not object to these words being added. It was really a question of trade rivalry.

Mr. Justice EVE: But you are in the wrong.

Mr. TYLDESLEY JONES: Yes, since the Court of Appeal has determined the law, I do not desire to raise any question.

Mr. ROMER said in March last the defendants issued a circular stating that the rate of supply for lighting purposes, in view of the high price of coal, would be increased; but that it was their intention to grant a rebate of ½d. per unit where electricity was used as the only illuminant. It was proposed to raise the price throughout the area; but in certain cases the defendants were willing to allow a rebate on condition that electricity only was used as an illuminant. The defendants made a mistake at the time the writ was issued, and continued to do so; and afterwards they discontinued allowing the rebate. Now the plaintiffs asked for a declaration and an injunction. The defence stated that the defendants admitted, after the issue of the circular and prior to the 1st of December, 1914, that they allowed the rebate to persons using a supply of electricity for illuminating purposes only, but they had since given this up. They admitted that they were acting in breach of the provisions of sections 19 and 20, and offered to submit to a declaration to that effect. The defence was silent as to an undertaking that they would not do it in the future; and therefore the plaintiffs asked for an injunction as well as a declaration. He suggested that the declaration should run as follows: "That defendants were acting in breach of the provisions of sections 19 and 20 of the Electric Lighting Act, 1882, in allowing a rebate to persons taking a supply of electricity from the defendants, on condition that only the defendants' supply be used as an illuminant." This embodied the point intended to be raised in the action. He asked also for an injunction following the terms of the declaration. He did not understand defendants to say a declaration alone would meet the justice of the case, as a declaration alone was of no particular value.

Mr. Justice EVE asked whether the defendants objected to the form of the declaration.

Mr. TYLDESLEY JONES replied that he did; saying that in all cases of undue preference it was, of course, permissible to electric lighting companies to differentiate between two consumers when the circumstances were different. In the Long Eaton case, evidence was called as to the instance in which it was said differentiation had taken place; and the matter was gone into at some length. Load factors and other technicalities were talked about; and the result was that the Judge held that the defendants were in the wrong. But the Court of Appeal made very short work of the case by deciding that the circular could not be justified. Take the case of two customers—one of whom took a supply wholly from the defendants and the other did not; the mere fact that the one took the whole supply did not prevent the defendants from giving a preference.

Mr. Justice EVE: On what ground?

Mr. TYLDESLEY JONES: Supposing a man lights his living room with electricity and his bedroom with gas; and you say to him if you make a change and light your bedroom by electricity, I can give you a better rate, that is a good ground for differentiation, as the demand for light to the bedroom would come on at a different time to the light for the sitting room, with the result that the same machine for producing the electricity could be used.

Mr. Justice EVE said the cause of action was really the circular.

Mr. TYLDESLEY JONES said he was prepared to submit to the same

declaration as Mr. Justice Sargant made, which was approved by the Court of Appeal. The order there was that, in making the differentiation referred to in the circular, the defendants were acting in breach of the provisions of the Act. He was prepared to assent to a declaration that the circular constituted a breach of the provisions of the Act. That was the only cause of action; and he could not go further than the admission in the defence, as he might be including cases not covered by the circular.

Mr. Justice EVE asked how the declaration differed from the notice of motion.

Mr. TYLDESLEY JONES said he should assent to the notice of motion with two additions: (1) Breach of sections 19 and 20 of the Act; and (2) on condition that defendants only supply electricity. Of course, they were entitled to supply candles.

Mr. ROMER said he did not object to the two additions, but suggested "½d. per unit" should be left out.

Mr. TYLDESLEY JONES said he did not object to that.

Mr. Justice EVE: Amend the notice of motion striking out "½d. per unit" and put in "in breach of sections 19 and 20 of the Electric Lighting Act" and the word "electricity" after "supply." He was not disposed to grant an injunction, as the declaration was sufficient—the defendants having submitted to it in their defence. There would be liberty to apply; and defendants must pay the costs of the action.

PREFERENTIAL CHARGES FOR ELECTRICITY AT ILFORD.

Attorney-General v. Ilford Urban District Council.

Last Wednesday, this action was mentioned to Mr. Justice Sargant, sitting in the Chancery Division of the High Court.

Mr. MARTELLI, K.C., said he had to apply that the proceedings should stand over till next sittings. The case was somewhat like that regarding Long Eaton recently decided, although he did not think it was covered by it. If the case was going to be fought, it would be necessary to call the Treasurer to speak to the accounts; but at present he was on service in the Eastern Counties. Certain proposals had been made by the plaintiffs to the Council, which were under consideration. The Council could not call a meeting this week; but anyhow it was a matter which required grave consideration—especially the exact terms. The case was an important one for the Council; and he understood plaintiffs' Counsel did not object to a postponement. If the case was not settled, it ought to be tried early next term. He understood briefs had been delivered on the other side.

Mr. MARK ROMER, K.C., said the plaintiffs were not anxious for a postponement; and they only agreed to it on the terms that his Lordship retained the action, and disposed of it early next sittings.

Mr. MARTELLI said if the case was to be tried, his clients would like his Lordship to try it. He thought there was more than a chance of the case being settled.

His LORDSHIP said he would take the case in the first week of next sittings.

Mr. ROMER said to that he would raise no opposition.

His LORDSHIP asked how long the case would last.

Mr. MARTELLI thought it would probably occupy a full day. He understood his learned friend took the view that one branch of the case was covered by the Long Eaton decision.

Mr. ROMER said "Yes;" and in his view the other branch was covered by other decisions.

His LORDSHIP said he would take the case on the second day of next term, which commences on Jan. 11.

SERIOUS CHARGES AGAINST FORMER GAS OFFICIALS.

Defalcations Alleged to Amount to £2319.

A Special Sitting of the Kingston County Bench was held on Monday last week for the purpose of hearing charges brought by the Walton-on-Thames and Weybridge Gas Company against Thomas Henry Lamb, until recently the Secretary of the Company, and George Waters Ross, also until recently, the Chief Clerk and Collector, and likewise a member of the Urban District Council, of stealing, on different dates between the 1st of April and the 22nd of September, various sums of money the property of the Company. Ross was charged on the 5th ult., and remanded, as it was stated that there was another person concerned who had not been arrested [*ante*, p. 315.] This was the former Secretary. Mr. W. L. J. Crosby appeared to prosecute; Mr. Comyns Carr defended Mr. Lamb.

Mr. Crosby stated that Lamb had been in the Company's service for 23 years, and had for a long time been the Secretary, with a salary of £265 a year, a house, and gas and coals free. Ross had been in the Company's employ one year less than Lamb, and was Chief Clerk and Collector, with a salary of £170 per annum. The duty of the defendants was, when cash was paid in, immediately to enter it in the daily cash receipt book. The Company sold their bye-products, and cheques for large amounts in payment therefor had been received but never entered. Four customers would be called who would produce the actual cheques which had been returned to them in the ordinary course through the bank, endorsed in the handwriting of the defendant Lamb; the Manager of the Company would prove that certain recorded receipts in the cash-book did not include these cheques; and the Bank Manager would produce credit slips showing that the cheques had been used against the recorded receipts in the cash-book. There was a fifth charge, of grave character, concerning payments by the London and South-Western Railway Company in respect of gas used at their stations. The account rendered was for £89 0s. 10d.; and this sum was paid by the Company. But the cash-book, in the handwriting of Ross, showed a receipt of only £71 10s. 10d. The prepayment meter collector paid into the Secretary's office between July 25 and Sept. 22 the sum of £1022 11s. 2d. The cash receipt-book showed only £520 as having been received during this period, and no more than this had been paid into the bank. After the defendants had been suspended, there was cash found in the safe to the amount of £34 19s. When this was added to the sum paid into the bank, and deducted from the total, the deficiency was £467 12s. 2d. These discrepancies were detected by Mr. Price, the Manager; and when Ross was asked for an explanation he said he did it for Mr. Lamb, who had had the money. The latter, on being spoken to by the Manager, implored him not to say anything about it, as he could make it right in 24 hours. He said he had used the money to meet losses on the Stock Exchange. As to Ross, Mr. Crosby alleged that it was he who falsified the meter ledger and the daily cash receipt-book, entered the cheques on the credit side, and omitted to enter the receipts in the cash-book.

Evidence having been given by representatives of the firms who had sent cheques, the Manager of the Walton-on-Thames branch of the London and South-Western Bank, the prepayment meter collector, and the Manager, one of the Directors (Mr. W. A. Bilney, J.P.) was called, and gave an account of an interview he and two other Directors had with Lamb on the 23rd of September, when Lamb confessed to having taken about £300, spread over eighteen months. He said he had had some speculations on the Stock Exchange and had lost money. When he wanted any he used to ask Ross for it, and it was generally about £20 a month. Ross was called in, and he acknowledged that he took money and gave it to Lamb, because he was such a good master.

At this point the hearing was adjourned till Friday, when Mr. Bilney gave further evidence, in the course of which he stated that the Auditors had given a certificate of defalcations amounting to £2319 for the past eighteen months. After further evidence had been given, Mr. Crosby asked the Bench to commit the defendants for trial at Quarter Sessions, not only on the charges on the sheet, but on others which had been elicited in evidence. Both defendants pleaded "Not guilty;" and the Bench complied with Mr. Crosby's request. Mr. Comyns Carr, however, submitted that the case should go to the Assizes, Mr. Bilney being a member of the Court of Quarter Sessions; and he gave notice that it might be his duty to make an application to the High Court on the matter. The accused were remanded on bail.

A Question of Liability.

At the Edmonton County Court, on Monday last week, the Tottenham Light, Heat, and Power Company sued Mr. Charles Smith for £13 1s., for gas-fittings, &c., supplied to the West Green Electric Theatre, of which he was a Director. Defendant said he made an agreement with the Company to pay for the gas consumed at the theatre, which was now closed. His co-Director was a Mr. Thorn, who was the Managing-Director. It was necessary to give a guarantee for the rent of meters and radiators, and defendant agreed to give it. The Theatre Company failed from the commencement, and went into liquidation; and the Gas Company sent in a bill for the gas consumed, which he paid. They also sent in an account, for "running supplies," which he disputed. For the Gas Company, it was stated that they concluded that they did the work for the defendant, and held him responsible for the whole thing. They did not recognize Mr. Thorn at all. As Mr. Thorn was in possession of the theatre, the case was adjourned until next month for him to be called as a witness.

Nottingham Gas Charges.

The fact that without discussion, the report of the Gas Committee [*ante*, p. 557] was adopted at the last meeting of the Corporation, was, says our Nottingham Correspondent, significant of an altered feeling upon the part of that body in relation to the undertaking. In some circumstances, judging from past local experiences, there might have been an outburst of seeming indignation, especially upon the part of some self-constituted champions of the interests of the working classes. But the logic of the situation was inexorable; all acquiescing in the view that, with the general depression occasioned by the war, it would be inopportune to carry out the proposed reduction in price in January next. The matter is deferred for a period of six months; the Committee readily securing the power to further extend the date for the reduction in the event of depression in trade continuing to affect adversely the work of the undertaking.

The Power-Gas Corporation.—Reporting on the operations of the Corporation during the past year, the Directors state that business has been satisfactory. The works at Stockton have been maintained in a state of thorough efficiency and repair, and all expenditure for this purpose has been charged to revenue. They were fully employed until the outbreak of the war; but since then the output has been reduced. The Directors have appointed Mr. Wilfrid Beswick (the General Manager and Secretary) to a seat on the Board; and his appointment will come before the meeting for confirmation. The results for the year show a total profit of £20,510, to which has been added £3550 brought forward, making altogether £24,060. This the Directors propose to apply as follows: To reserve fund, £4100; a dividend of 5 per cent. per annum (less income-tax) upon the ordinary shares, £12,481; balance to be carried forward, £7479.

Sequel to an Electrical Breakdown at Marylebone.—The following reference to the Marylebone electricity undertaking appears in the "Electrical Times" news columns: "In September last, the undertaking experienced a breakdown which was attributed to the action of an employee of the Gas Light and Coke Company, who, in searching for an escape of gas in Gloucester Place, stuck a pick into two of the main trunk feeders from the generating station to Manchester Square. In due course the Council made a claim against the Company for £550, a portion of which was claimed for consequential damages. Efforts to arrive at a settlement were unsuccessful until recently, when the General Managers of both undertakings met and discussed the case. The Committee have now received an offer from the Solicitors to the Gas Light and Coke Company to settle the matter, without admitting liability, by paying the reduced sum of £200 14s. 8d.; each party paying its own costs. The Borough Council have decided, in the circumstances, to withdraw the action against the Company upon the foregoing terms."

MISCELLANEOUS NEWS.

CONTINENTAL UNION GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, 7, Drapers' Gardens, E.C.—Colonel H. Le Roy-Lewis, C.B., D.S.O., in the chair.

The Secretary (Mr. William Martin) read the notice convening the meeting; and the Directors' report and the statement of accounts were taken as read.

A Prophecy Fulfilled.

The Chairman moved—"That the report and accounts be received and adopted." He said that, before putting the motion formally to the meeting, he should like to say a few words in review of the operations of the last financial year. Those of the proprietors who happened to be at the meeting a year ago would perhaps remember that, when he had the honour of addressing them, he indulged in that very dangerous but very fascinating form of pastime—an incursion into the realms of prophecy; and he told them that he hoped, at the end of the then current financial year, to present them a report which would be at any rate not worse than the one he was then submitting. In so far as these remarks were concerned, he thought they were justified. The report and the accounts which he had to put before them that day were certainly not worse – indeed, they had improved upon to a certain (he might almost say considerable) extent those of last year. He need hardly remind the proprietors that, had it not been for the fact that they were living in times which could not be called normal, the result of the year's working would have been very different indeed.

A financial comparison.

He thought it might not be amiss to look briefly through the figures of the balance-sheet. There were one or two facts to which he wished to call special attention; but the remaining figures really called for no special remark. It would be noticed that the management and general charges (£2529) were down a little; and the pensions in London and Messina (£1461), which did not always become payable at exactly the same date, showed a slight increase. The question of income-tax he would have to deal with separately. On the other side of the general revenue account, there was an increase of slightly over £2000 in the dividends and interest (£67,030) received. The sundry receipts (£312) were slightly down. In the appropriation of net revenue account, nothing very salient called for attention, except the fact that he thought this was the last time that the horrible word "Messina" would appear in the balance-sheet. As a matter of fact, they had no entry against it this year; but they were compelled to put it in on this occasion in order to show by way of comparison what happened last year. The item depreciation of investments he would have to deal with specially presently. The other items in the appropriation of net revenue account or in the balance-sheet he did not think called for any particular notice.

Amount of income-tax.

There was in the general revenue account, the item of income-tax to which he wished to call attention. When these accounts were made up, the Directors were naturally not aware of the fact that the rate of income-tax would be doubled. Consequently, the Board appropriated the sum necessary to pay the income-tax on the basis for the then existing tax. But since the report was issued, they had had some correspondence with the income-tax authorities, and had discovered that they would have to pay at the rate of 1s. 8d.; the proprietors being charged 1s. 5d.—the average rate up to June 30 last. Now, of course, they would have to deduct this 1s. 5d. from the net amount payable to the proprietors; and they would have, in next year's accounts, to take the extra sum from the carry-forward. This would be the easiest way of dealing with the matter, and the best way of adjusting the accounts. He must apologize for the incomplete form in which these accounts were presented; but it would be realized that this was not the fault of the Directors. They could not get, until a day or two ago, any final decision from the Income-Tax Commissioners, and so they were unable to make the adjustment in time.

Question of depreciation of investments.

Regarding the appropriation of net revenue account, he wished to call attention to the item of depreciation of investments. Last year the Board of Directors made provision for the total amount of the depreciation of their investments; and it reached the sum of £7400. This year, when the accounts were made up on June 30, and they came to value their stocks, they found there had been no depreciation, which was naturally a very satisfactory showing. At the end of July, an entirely different state of things prevailed. He then had a fresh valuation made; and he thought it might interest the proprietors to know that, in the month succeeding the closing of the accounts at the end of June, the total depreciation of their investments (for the month) only amounted to £7000—a small amount spread over a million of capital. After that date, of course, all had been absolutely dark; and they could not possibly proceed to any further reliable valuation of the investments, and, even if they could, in these abnormal times, he did not think any useful purpose would be served. They had simply to bear their souls in patience, and wait until daylight emerged from the present fearful chaos.

A matter of prudence.

Turning to the balance-sheet, there was one item to which he wished to draw special attention—that was dividends accrued, £56,344, and to the footnote, which stated: "This sum includes £29,967 3s. 7d. dividends on the holding of Cie. l'Union des Gaz shares not yet payable." The reason for this was that the Union des Gaz, in which they had a large and substantial interest, had thought it necessary, in view of the extremely delicate financial situation, to keep their resources more liquid than it was the custom to do; and the Directors of the Company had consequently, taking advantage of the Articles of Association, decided to declare the same dividend, which had been more than earned—he might say earned with a considerably better showing than the year before—but to defer the payment of the dividend until a date not later than June 30. It was probable that instalments of the dividend, and, in fact, the whole dividend itself, would be paid before the end of June; but, at any rate, they could not rely upon receiving it until then. As the financial situation of the Company was quite sound and satisfactory—as their cash position was a perfectly satisfactory one—he saw no reason for deferring the payment of the somewhat modest sum that the Directors proposed to distribute to the proprietors on an early date this year. Therefore, so far as the Continental Union Company were concerned, the postponement of the payment of the dividend by the Union des Gaz made no difference; but the Board thought it was only right to draw the special attention of the proprietors to the fact that the payment of the Union des Gaz dividend had been deferred from the usual time.

The scenes of the activities of the Union des Gaz.

The proprietors had often heard at these meetings that the Company had large interests in the Union des Gaz; and he believed some of them followed closely (he knew they asked for the reports from time to time) the fortunes of that Company. But to some of them, he dare say, the Union des Gaz was merely a name. Now he should like, in view of the fact that so many of their colleagues in the gas world were not in a very pleasant position at the moment, to give a brief survey of the field of operations and the activities of the French Company. In the first place, he must tell the proprietors, what was no doubt known to all, that the Union des Gaz was purely a French Company, with a French President and French members upon the Board, and with an office in Paris, and a French Secretary—a young gentleman who was a personal friend of all the members of the Board, and who, at present, he (the Chairman) was happy to say, was gallantly defending his country in the trenches on the River Aisne, and from whom they had good news until quite a recent date. These were the officers of the Union des Gaz; and the whole operations and activities of the Company were French. The stations which were supplied by the Union des Gaz fell, roughly speaking, under four heads. There was first of all the group of stations near Paris, including a large portion of the north-western suburbs of the city. These stations had been to a certain extent affected by the war, but not to a terrible extent. Then there was the group of stations lying on or near the littoral of the Mediterranean; the largest of them being Cette—a considerable port on the Mediterranean—and another the town of Nîmes, which some of the proprietors would no doubt know well. Thus, so far as the South of France was concerned, the condition of affairs was quite satisfactory; and the war, far from having brought any depression to that part of the world, had perhaps rather on the whole benefited it. The third lot of stations in France were grouped about in the neighbourhood of the town of Lyons; and although there was no particular activity at these stations, yet they had not been injuriously affected by the war. The fourth, and by far the most important group of the stations of the Union des Gaz, lay in Italy, and included among others the two towns of Milan and Genoa. Now Italy, as the shareholders knew, was out of the present turmoil; and he was happy to say that, so far as could possibly be seen at the moment, their business there was not only being maintained at its old level, but was perhaps rather benefited on balance. Therefore, the proprietors would see that the whole group of stations which the Company actively operated were well removed from the scenes of the war. There was another interest which they had in the Union des Gaz, and regarding which he noticed some misapprehension existed in various financial papers. This was respecting the large and important town of Strasburg. This was a station of the Union des Gaz until the beginning of this year; and he was happy to tell the proprietors that the Board of the Union des Gaz then sold the business to a German Company. The Union des Gaz retained a substantial interest in the mortgages of the station; but he yet had to learn that Germany would not at the end of the war respect engagements in the shape of private property, mortgages, and so on. He thought such a thing was quite inconceivable; and he had no doubt in his mind that, so far as the Strasburg station was concerned, they would come out quite right. The responsibility of the Union des Gaz, as an operating agent, for the town of Strasburg ceased from the beginning of this financial year.

The progress of a decade.

This briefly was the field of the activities of the Union des Gaz. He should now like to give to the proprietors a statement of a few of the results of that Company, taking for comparison the period of ten years. He had taken the year ending June, 1904, and the year ending June, 1914, which were normal ones, with nothing at all special about them. In 1904, the amount of gas sold was 91 million cubic metres; in 1914 134 million cubic metres—an increase of 46 per cent. in the ten years. The quantity of coal carbonized in 1904 was 367,000 tons, in 1914, 463,000 tons, or an increase of 26 per cent. He would like to draw special attention to this last figure, because it was seen that, although the amount of gas sold increased by 46 per cent., they required only 26 per cent. more coal to produce it. This was a very satisfactory result from the technical side; and he thought that one member of the Board deserved to be specially congratulated upon the result. It was due largely to his activity, and to the care he had taken in re-building their somewhat antiquated works, that so good a result had been obtained. He (the Chairman) need scarcely say that he referred to Mr. A. F. Phillips. Then in the year 1904, the number of consumers was 184,000; in 1914, 300,000—an increase of 62 per cent. The number of meters on hire showed an even more remarkable result. In 1904, there were 144,000 meters on hire; in 1914, there were 279,000—an increase of 92 per cent. If they took the net profits alone, it would be found that in 1904, they amounted to 2,086,000 frs.; whereas by 1914 they had advanced to 3,218,000 frs., or an increase of 54 per cent. If they took together profits and carry-forward, it would be seen that the Board of the Union des Gaz had adopted a conservative policy all this time, and that the result was more remarkable. The profits and carry-forward together in the year 1904 amounted to 2,350,000 frs.; and in 1914, to 4,124,000 frs., or an increase of 75 per cent. These profits had been obtained by an increase of capital amounting to only about 34 per cent.

He did not think these figures were at all bad reading; and he felt convinced that, when the proprietors took this brief review of the activities of the Union des Gaz into consideration, they would see that they need not be afraid for the future of the investment which represented such a very large amount of their Company's assets.

CHARITABLE CONTRIBUTIONS.

Before he sat down, there was one point upon which he should like to ask for the advice and direction of the proprietors. It seemed to him that, when a Board of Directors in a concern which could not but be considered fairly prosperous, considering the bad times through which they were passing, met the proprietors, they should ask their direction as to whether they did not think it a right and proper thing to apply a portion of the profits earned during the year to charitable objects connected with the war. He knew perfectly well the Board had without authority no right to apply the money of the proprietors in this way; but if they had a direct expression of opinion from the proprietors' side of the table, they might be quite certain it would meet with no opposition from the Directors. ["Hear, hear."]

REDUCTION OF DIVIDEND ONLY A MATTER OF PRUDENCE.

To sum up, there were only two salient features in the report this year. One was the reduction of the dividend by ½ per cent., which erred on the side of prudence. It was not a great reduction considering the badness of the times; and the large increase of the carry-forward—an increase from £6000 to £23,000—was also simply dictated by prudence. They did not anticipate any cataclysm would happen to the Company; but at the end of the war, things would be so profoundly modified that the Directors would like to be able to meet the proprietors with as good a balance-sheet as that which they presented that day. He did not at the moment see that there were any causes for anxiety in their Company other than those which there must be in every company. It was quite possible their large holding in the Union des Gaz might be affected, and affected detrimentally, by Italy coming into the European conflagration. As they all read the papers, they could see clearly that this was a contingency it was not wise to disregard. Again, at the end of the war, they might be faced with very heavy and permanent depreciation of their investments. He did not anticipate it; but it was certainly on the cards. It was for this reason the Directors had to present to the proprietors that day a report which was tinged all through by what he hoped would be considered a virtue —viz., by prudence.

Mr. H. BIRCHENOUGH, C.M.G., seconded the motion.

Mr. J. F. REMNANT, M.P., remarked that two years ago he had the honour of congratulating Colonel Le Roy-Lewis upon his election to the chair of the Company. There were many proprietors on that occasion who endorsed his remarks, and now he could say that it was a matter for sincere congratulation to the proprietors that his chairmanship had been marked by such great ability. If confirmation of this were wanted, it would be found in the present condition of the Company. At that time, the Chairman had steered them through the troubled waters of the Messina business; and to-day the proprietors were delighted to hear the Chairman say that this was the last time they would see the name of Messina in the report and balance-sheet. Did this apply to the pensions given in Messina? Were they to cease to appear in the revenue account?

The CHAIRMAN: No. There are just one or two small pensions—no increase.

Mr. REMNANT (continuing) said the Company were badly treated out there; but one felt one ought to keep the pensions going at whatever cost. Of course no one could have foreseen that, within a short period of Colonel Le Roy-Lewis's election to the chair (it was within a year, he believed), they would be on the brink of a serious European war, and that within two years they would be actually in one of the most ghastly wars the world had ever seen, or was likely to see again. The result of this was the wholesale disorganization of business throughout the country; and therefore the action of the Board of Directors in carrying forward £23,088 must be one which would meet with the very hearty approval of every business man among the proprietors. No one could possibly foresee what would happen at the end of the war, or how long the war would last. But what he had seen of this Company led him to believe very confidently that, when the war was over, and they had a revival of trade, the way the Company had been managed would enable it to take advantage of the revival. One thing he should like to allude to, and it was that some provision should be made for helping to relieve those of their sailors and soldiers (as well as their dependants) who were upholding the honour of this country at the front. All great concerns, so far as he had seen, had recently devoted some of their funds towards this desirable object; and he should therefore like to move, when the proper time came, that a certain sum from the carry-forward should be placed at the disposal of the Board to be given to one or more of the great funds. He should like to suggest £500. Concluding his remarks, he congratulated the Board on the satisfactory position of the Company.

Mr. CAVE ORME asked the amount of capital now employed by the Union des Gaz compared with 1904.

Mr. H. C. DAVENPORT said, as he understood the Treasury minute, the income-tax was to be 1s. 8d.; but he understood from the Chairman that only 1s. 5d. was to be deducted from the dividend to be paid in January.

The CHAIRMAN: Yes, that is so.

Mr. G. A. TOUCHE, M.P.: It is 1s. 8d. for three months, and 1s. 2d. for three months.

Mr. REMNANT: The balance forward—£23,000—you suggest will be smaller next year by the amount of the extra increased tax. This, he supposed, would appear as a separate item.

The CHAIRMAN: Yes. Proceeding, he said in reply to Mr. Cave Orme that the capital of the Union des Gaz had been increased by £400,000, out of a capital of £1,400,000. There were nearly £2,000,000 of debentures as well, so that the increase of capital was small, and indeed insignificant, compared with the whole financial sum involved.

The motion was unanimously carried.

Proposed by the CHAIRMAN, and seconded by Mr. A. F. PHILLIPS, dividends were declared at the rate of 4 per cent. on the ordinary stock and 7 per cent. on the preference stock (deducting the interim dividend of 2 per cent. on the ordinary stock and 3½ per cent. on the preference stock), both less income-tax.

ILLNESS OF MR. ARTHUR LUCAS.

The CHAIRMAN next moved the re-election of his old friend Mr. Arthur Lucas to his seat at the Board. He said he much regretted to say that Mr. Lucas was seriously ill, and had to go into a nursing-home. The reports received about him the previous night were disquieting, but the proprietors who had known his face so long at the Board would join with him (the Chairman) in wishing Mr. Lucas a speedy return to health.

Mr. TOUCHE, in seconding, said he most earnestly shared the hope expressed by the Chairman that Mr. Lucas, who was one of the oldest and best friends the Company had ever had, would soon be completely restored to health.

The motion was cordially passed.

Proposed by the CHAIRMAN, seconded by Mr. E. GOULDING, M.P., Mr. A. F. Phillips was also re-elected a member of the Board.

Mr. REMNANT next proposed that the sum of £500 be placed at the disposal of the Board for distribution as thought desirable among the funds now being raised in this country.

The CHAIRMAN remarked that the Union des Gaz were also distributing a substantial sum for charitable purposes in France.

Mr. CAVE ORME seconded the motion, which was heartily adopted.

Mr. REMNANT proposed the re-election of the Auditors (Mr. A. T. Eastman and Mr. C. P. Crookenden, F.C.A.), at a total fee of £105.

Mr. R. STEVENS seconded the proposition, which was unanimously agreed to.

Moved by Mr. REMNANT, and seconded by Mr. H. H. SALOMONS, a cordial vote of thanks was passed to the Chairman and Directors.

DUBLIN PUBLIC LIGHTING DEPARTMENT.

Improvements Effected in the Past Five Years.

In connection with the relinquishment by Mr. Henry F. Cotton of the position of Superintendent of Public Lighting and City Gas Examiner of Dublin, referred to last week and again in our "Personal" column to-day, the following particulars in regard to the improvements carried out by him may be given, by way of supplementing those that have already appeared.

Taking first the street lighting department, it may be said that in 1909 it existed only in name. The building known as the Public Lighting Office was a mere shell; there were no proper offices, no regular stores or stock-keeping, and very poor facilities for carrying out the necessary tests in connection with the gas supply. Since then it has been necessary to construct proper offices, institute a stores and a system of stock-keeping on the card system, and construct a laboratory and a suitable room with a time-recorder for dealing with the street department. When Mr. Cotton took up his duties in 1909, he found that the city was lighted by 4426 gas-lamps. The arc and metallic filament lamps were then under the control of the Electricity Department, and the gas-lamps were of an obsolete type. Of the entire number of these lamps about 3726 were fitted with flat-flame burners, and the remaining 700 with an old type of upright burner. The plant had not been improved for more than thirty years, and the necessary maintenance charges had been so curtailed each year that it was in a state of dilapidation. On this account the cost of bringing it up to date has made the maintenance charges heavy during the past few years.

After considerable trouble Mr. Cotton designed a lamp which has since been so improved upon that he claims it to be the best street-lamp of its kind on the market. It is constructed and finished in the Corporation's own workshops at Tara Street. It has reduced the consumption of mantles to as low as five per lamp per annum, and has abolished the use of a pilot-light; and Mr. Cotton considers that it should last for upwards of twenty years. In connection with this lamp, patent rights have been applied for in the Corporation interest. At present the total number of gas-lamps in the city is as follows: Inverted incandescent, 2467; upright incandescent, 1970. There are no flat-flame burners in use. These lamps are situated in the various districts; 3345 of them being in the city.

Mr. Cotton put before the Lighting Committee a scheme for dealing with public lighting on a scale system of charging which should realize a large annual saving on the cost of public gas lighting. But as he is leaving the service of the Corporation, he will not have an opportunity of bringing it into operation.

Automatic controllers have been introduced on the far outlying districts to the number of 329; and the saving in gas per annum amounts to £523 7s. The breakage of glass in the public lamps has been reduced to a minimum. During the month of April last, the number of panes broken was 721, while during October it was 306.

With regard to public electric lighting, in 1912 all the metallic filament lamps, numbering 161, were transferred to the charge of the Public Lighting Department. These lamps have since been dealt with without any addition to the then existing staff. The number of these lamps now in use is 450.

The income derived from the meter-testing department during the past five years amounts to £1341 14s. 8d. (deducting working expenses). The income increased owing to the fact that Mr. Cotton succeeded in getting Messrs. Parkinson and W. & B. Cowan to send their meters for testing from Belfast to Dublin, instead of to Manchester as formerly. The use of gas for testing meters has been abolished, thereby effecting a saving of £25 per annum.

In the gas and lamp testing laboratory there is in use complete equipment for testing any lamp, gas or electric, up to 3000-candle power; and all the lamps sent out are tested. The Lighting Committee realized that it was desirable to endeavour to light the public thoroughfares according to their requirements in foot-candles; and for this reason a portable photometer has been obtained to find the best method

of lighting each of the streets under the conditions existing. Fully detailed tests are also made in the laboratory of the gas supply—as to its illuminating power in candles, heating value in British thermal units, sulphur compounds, sulphuretted hydrogen, naphthalene, &c. These tests are submitted to the Committee and to the Press.

Mr. Cotton promoted the following new public lighting schemes, of which the Committee have approved, and which are being adopted: (1) The utilization of the tramline poles for central suspension lighting on all the routes; the feed wires being carried overhead. (2) The lighting of areas having narrow streets, narrow footways, and projections from the frontages, by means of lamps centrally suspended from the buildings. (3) In areas not suited to these methods, electric lighting by means of poles erected at intervals. Mr. Cotton has designed a special pole and ornamental arm for this work, and has obtained protection for it. It is taking the place of the existing columns, and is being erected at standard intervals and heights. By means of the street photometer, he has also obtained the most suitable form of reflector, and it is adopted in connection with the new poles. When these schemes have further developed, Mr. Cotton considers that Dublin will be one of the most up-to-date cities in the matter of street lighting.

THE DISPOSAL OF TOLUOL, ETC.

A War Office Notification.

To those whom it may concern, the War Office, in the early part of this month, issued the following notice. The intimation was, however, in the case of gas undertakings to which such a qualification would apply, accompanied by a statement to the effect that the Army Council are informed "that it is the practice of your company to sell your tar, and not yourselves to treat it. In this case, they trust that it will be possible to continue the present arrangements during the period of the war; but for that purpose it is necessary they should receive promptly particulars of the existing contracts, as mentioned in the notice, as otherwise there may be inconvenience and delay."

> The Army Council hereby notify to you that they require you to place at their disposal for the period of the present war the whole output of your undertaking in toluol or substances containing toluol—such as commercial benzol, light oils, or solvent naphtha—so far as the same are not covered by existing contracts.
>
> As the Council are desirous of interfering as little as possible with existing contracts for the sale and distribution of these products, they will endeavour to leave in your hands such portion of your output as is covered by those contracts, so as to enable you to perform all such contracts as you have already entered into with regard to any portion of such output.
>
> The possibility of so doing must, however, depend on whether it is consistent with the requirements of national defence. Should you, therefore, have entered into any such contracts prior to this date, you are requested to give notice of same, with full particulars of each contract, to the Secretary of the Committee on the Supply of High Explosives, Storey's Gate, S.W., to whom all further correspondence on this subject should be addressed. The particulars asked for should reach the Secretary of the Committee not later than Dec. 5, and they will at once be considered, and the decision with regard to the portion of your output which they cover will be duly communicated to you.

A supplement to the "London Gazette," dated Saturday, amends the Proclamation prohibiting the exportation from the United Kingdom of certain warlike stores, by adding aniline oil, aniline salt, and picric salt and its components to the list of articles the export of which is prohibited to all destinations.

REPORT OF THE AMERICAN INSTITUTE REFRACTORY MATERIALS COMMITTEE.

[From the December Issue of the "American Gas Institute News."]

By way of introduction to this, the first report of the Refractory Materials Committee, it will not be amiss to state briefly the scope of the work of this Committee.

In its broadest aspect this should be to place before the gas engineer, builder, and fire-brick manufacturer information which will enable them to select and produce the refractory material which will prove most efficient for the required work.

In order to accomplish this, it is necessary to know first the conditions which the refractory material must meet in practice; second, the qualities the material must possess in order to best meet these conditions; and, third, we must have satisfactory methods of testing refractory materials for these qualities. Such information will result in more intelligent use of refractory material by gas engineers, and an improved product by fire-brick manufacturers.

It is quite evident that satisfactory progress in the study of these problems demands the sincere co-operation of three parties—the maker, the builder, and the user. The last two are well represented on your Committee. The securing of the co-operation of the maker has been taken care of through the agency of the Committee on Gas Refractories of the Refractory Manufacturers Association—most of whose Committee members are also members of the Institute. The work which has been accomplished is a result of the joint action of the two Committees; and all the meetings to date have been joint sessions. These meetings have been productive of a spirit of fairness, co-opera-

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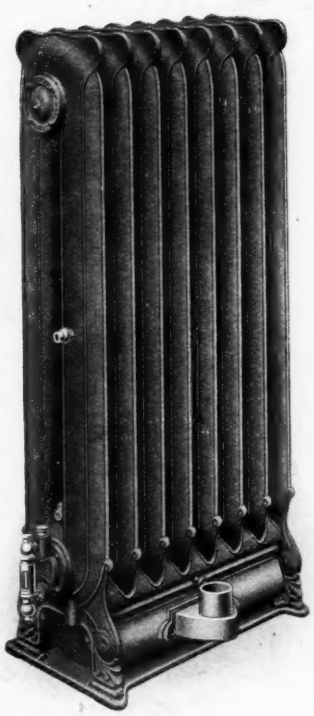

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VENTILATING "St. ANDREW."

Its flue meets these special cases, but as such a modification of a Radiator naturally involves various disadvantages, we only recommend it in the few exceptional cases of necessity.

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Eureka Works, BIRMINGHAM.

tion, and open-mindedness on the part of all, that has been most gratifying. It is perhaps not out of place to say here that the appointment of your Committee, and the starting of this study, was in a great measure due to the suggestion of the manufacturers of refractory material.

It was also found that a great deal of work had been done by the Bureau of Standards, and that the Bureau on Refractory Materials should be of great assistance to the work of the Committees, and Mr. A. V. Bleininger, Ceramic Chemist of the Bureau of Standards, kindly consented to act as a member of the Committee, with the approval of the Bureau. Mr. Bleininger is also Chairman of Committee "C-8" on Refractory Materials of the American Society of Testing Materials.

Inasmuch as the American Society for Testing Materials had appointed a Committee on Refractory Materials, whose duty it is to prepare standard methods of test for such materials, your Committee decided to conduct this part of its investigations in co-operation with this Committee. Sub-Committees will prepare standard methods covering the following properties of refractory material: Fusion points; chemical and mineralogical analyses; thermal conductivity and expansion; porosity and permanent volume changes; load tests; crushing, abrasion, and other physical tests; slugging action.

Your Committee is now securing data to forward to those Sub-Committees; so that they will be able to give us very soon tentative methods of tests of gas industry refractory material. By means of circular and individual letters sent to many representative gas engineers and gas-works builders, your Committee tried to ascertain the temperature and loading conditions to which refractory material is being subjected at the present time in various types of carbonizing plants. The replies show that in modern carbonizing plants we may expect normal operating temperatures as follows:

Place and Temperature, Degrees Fahr.

Furnace.	Combustion Chamber.	Interior Carbonizing Chamber.	First Pass Waste Gas Flue.	Second Pass Waste Gas Flue.
1600 to 2400 ..	1600 to 2700 ..	1500 to 2400 ..	1300 to 2200 ..	570 to 1600

The maximum temperature to be expected under abnormal conditions is given by several observers as 3000° Fahr. The maximum load in the settings varies with the different types of plants at from 12 to 28 lbs. per square inch; and the temperatures at these points of maximum load vary from 2000° to 2600° Fahr. As to the question whether they would operate their settings at higher temperatures provided the material would safely stand such temperatures, opinion was about equally divided. This information has been tabulated, and will be used in the preparation of standard methods of test and will be of material help to the Committee in its future studies.

The Committee desires to report progress on the matter of the preparation of standard specifications for fire-clay and silica material for gas-works' use. Practically all the time of the last three meetings of the Committee has been devoted to the discussion of these specifications. Your Committee finds that it will be necessary to conduct rather elaborate experiments in order to determine the behaviour of silica and clay materials under load at high temperatures. These experiments have been arranged for, and will be conducted at the testing laboratory of the Bureau of Standards, in Pittsburgh, under the direction of Professor A. V. Bleininger. We believe that the result of these experiments will enable us to specify refractory qualities of material that will be satisfactory both to the users and manufacturers.

We have corresponded with representative technical schools and universities, as well as the Bureau of Standards, and all have assured the Committee of their co-operation in the carrying out of tests.

We have arranged, through Mr. F. J. Bywater, the Secretary of the Refractory Committee of the English Institution of Gas Engineers, for an interchange of information. The results of their investigations have been a material help to your Committee; and we in return have been able to reciprocate, especially in the matter of silica material.

Your Committee feels that it has made only a start in the work which is to be done, and believe that the Refractory Materials Committee should be a permanent one. The work this coming year will consist in the completion of the standard specifications, the preparation of standard methods of test, and an investigation of the properties of refractory material, together with a study of operating conditions, in order to determine the qualities a fire-brick material should possess to fit it for a given gas-works use.

(Signed) HERMAN RUSSELL, *Chairman*,
J. W. BATTEN,
W. H. BLAUVELT,
J. S. DEHART,
J. P. KENNEDY,
C. J. RAMSBURG,
J. H. TAUSSIG,
H. L. UNDERHILL,
W. H. FULWEILER,
} *Committee on Refractory Materials.*

THE NATIONAL DYE QUESTION.

Lord Moulton at Manchester.

In connection with the Government scheme for establishing on a firm basis the manufacture of synthetic dyes in this country, a meeting of North of England business men was held in the Manchester Town Hall last Tuesday. There were present one or two officials connected with Lancashire gas undertakings and several chemists. The LORD MAYOR (Alderman D. M'Cabe, J.P.) introduced Lord Moulton as the Chairman of the Government Sub-Committee on Dye Supplies.

Lord MOULTON said the English resources were still great. He confessed that this problem had caused him much reflection and serious

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The "Lancet," 14th November, 1914, page 1162.

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consideration. They were at a crisis of national fate. Nothing he had seen had weakened—or even had failed to strengthen—his feeling of the gravity of the problem. The consequence had been that he had been driven to a certain conclusion; and this opinion he had not hesitated to place in the clearest language before the Government, who had taken an unusual and an almost unprecedented step. Alluding to the conditional offer of the Government to guarantee the interest on £1,500,000 of 4 per cent. first mortgage debentures in a British limited company, under British control, with a large share capital, for the production of synthetic colours and dyes, Lord Moulton said he was not responsible for the details or the form in which Government action was to take place, otherwise than so far as it had been a necessary consequence of the advice he had given. When he made inquiries, he found that England consumed about 2 millions sterling worth of dyes, which were essential to an industry of something like 200 millions sterling per annum and involving 1½ million workpeople. Yet barely one-tenth of these dyes were provided within the boundaries of this country. Presuming that peace was declared to-morrow between England and Germany, the dyeing industries would remain under a domination as absolute as that in which they hoped to place us in a political or military sense. He advised the British manufacturers to take action in the matter. England did not lose the aniline dye trade, because they did not invent it. The sole cause of England falling back, and Germany taking possession of this great industry, was that the Germans took the intellectual trouble necessary to master the new science. He advised his audience to make careers for their young chemists. The whole of the dyes could be prepared in England if they were willing to put down the plant, just as they could manufacture a casting. He advocated that the matter of dyes should be studied. There was no mystery to the chemist. Competition in production was not impossible. He advocated a great national effort being made, and a large company being formed, to produce dyes of sufficient quantity to satisfy English demands. They knew that if such an effort was not made, they would be ruthlessly overcharged by the Germans. Such a company, however, Lord Moulton concluded, must be a powerful one, and one of which its loyalty was beyond any doubt whatever. To secure these conditions, Government assistance was necessary.

A resolution was moved and carried in favour of the formation of a company on the lines suggested.

Chesterfield Water Supply.—Though there is apparently no reason for doubting the adequacy of the Chesterfield water supply for the service of the town and district, the Gas and Water Board have decided to spend £50,000 upon extensions. The work, which is shortly to be undertaken, comprises the first portion of the scheme for which the Board obtained parliamentary powers in 1911. A new gathering-ground is to be formed, and the work will include the making of a tunnel upwards of a mile in length for carrying the water therefrom to the present reservoirs.

NOTTINGHAM AND GERMAN MANTLES.

The subject of the reported purchase of a large quantity of German-made mantles by the Lighting Committee [*ante*, p. 495] was brought under consideration at the meeting of the Nottingham City Council held last week. An explanation of the circumstances, serving to place the matter in a different light from that previously suggested in many strong letters appearing in the local Press, had already been forthcoming from the Chairman of the Committee (Mr. R. A. Young). A feeling of some dissatisfaction seemed, however, still to exist.

Mr. JOHN MORRIS asked whether the Committee had purchased German mantles in preference to those of British make of equal merit, and, if so, why. He also asked who made the tests alluded to by the Chairman in his recently published letter.

Mr. YOUNG, in reply, said that, following upon the change of chairmanship, certain changes of policy were made by the Committee; the result being that when the war broke out they had barely enough mantles in stock to meet the Committee's wants over Christmas. By advertisement, tenders were invited for a further supply; but not a single firm offered to enter into a contract. All they were willing to do was to deliver such mantles as they had in stock at a given price. They submitted samples, which were subjected to searching test by the Gas Engineer. They were burned continuously for 80 hours, and received a certain amount of handling after the tests. The result was that the mantle which proved the best was a so-called British one; and the Committee purchased every one of these mantles offered to them, paying the highest price ever given in Nottingham. The mantle which emerged second best from the test was one that had previously been used upon 50 per cent. of the lamps in the city; this being a mantle sold under the auspices of the Nottingham Ironmongers' Association, and believed to be of German origin. The third and fourth best mantles were British. Irrespective of price, the Committee purchased all the best mantles they could get; and the remainder was split up between the second, third, and fourth mantles which were in stock. The mantles that might prove to be of German origin were less than 23 per cent. of the total supply; so that 77 per cent. were believed to be of British manufacture. The mantles alleged to be of German make were bought from a tradesman, who purchased them last March. He could not understand the motive for supplying the Press with such totally unreliable and misleading information as had been given them in this instance. ["Hear, hear."]

The "Mechanical World" Electrical Pocket-Book for 1915 (which is published by Messrs. Emmott and Co., Limited, of No. 65, King Street, Manchester, at the modest price of 6d. net) contains a large amount of useful information on a variety of subjects connected with the electrical industry. There are a number of tables; and many different kinds of apparatus are illustrated and described.

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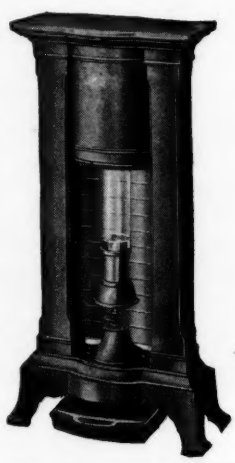

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WATER WORKS AND SUPPLY IN SCOTLAND.

Institution of Civil Engineers Presidential Address.

At the Opening Meeting of the Institution of Civil Engineers for the present session, the PRESIDENT (Mr. B. Hall Blyth, M.A.) delivered his Inaugural Address. It was devoted mainly to the progress of railway and other engineering in Scotland; but towards the close he referred to works for the supply of water for domestic and power purposes. This portion of the address is given below.

With regard to water-works, Glasgow has the advantage of a vast supply from Loch Katrine; and during the last fifty years the aqueduct for bringing the water from Milngavie into Glasgow has been duplicated, and a second service reservoir at Milngavie, called the Craigmaddie reservoir, has been constructed. This reservoir has a very deep puddle trench extending to 200 feet below the surface. The level of Loch Katrine was raised 5 feet some years ago, and it is in contemplation to duplicate the aqueduct from Loch Katrine to Milngavie.

The Corporation of Glasgow applied to Parliament this year for power to further largely increase the supply of water by raising the levels of Lochs Doine and Voil, and taking the water by a long tunnel into Loch Katrine for transmission to Glasgow. This scheme, or some substitute, must very soon be promoted again, as it is essential that an ample supply of water must be secured to Glasgow.

In the Edinburgh district the supply of water to the populace in 1864 was 724 cubic feet per minute, which is equal to 31·12 gallons per head per day to a population of 208,000. The water supply of Edinburgh was at that time in the hands of a Water Company, who managed their affairs, it was stated, not so much in the interests of the consumers of water as in those of the shareholders. After a great deal of quarrelling with the Corporation, and when a Bill promoted by the Corporation was in Parliament, an agreement was arranged by which the Corporation bought up the Company and established the presently existing Edinburgh and District Water Trust, composed of members of the Corporations of Edinburgh and Leith.

In 1874 the Trustees promoted a scheme to bring water from the Moorfoots to Edinburgh, giving an additional supply of nearly 9 million gallons per day, at an estimated cost of £324,000. This supply was duly introduced; but again a shortage of water became apparent, and in 1895 they introduced another Bill to bring water from the Talla, a branch of the Tweed. This scheme gives a further supply of 10 million gallons per day, and includes a reservoir with a storage capacity of 2800 million gallons. It has been so laid out that a further supply, when necessary, can be taken at a very small additional cost, by diverting the waters of the Fruid and the Menzion into the Talla reservoir. The supply of water to Edinburgh now amounts to 45 gallons per head per day. There is nothing very striking in connection with either the works of the Moorfoots or the Talla scheme.

Aberdeen promoted a scheme for an additional supply of water from the River Avon in 1909; but this was thrown out by the Committee to whom the Bill was referred. It is, however, essential, that some new supply of water should be got for Aberdeen. The present supply is very much over-taxed, and the culvert by which the water is conveyed to the town is in a very unsatisfactory condition, besides which the supply is drawn from the River Dee, only about 20 miles from the sea, above which point there are many villages and thousands of acres of highly-cultivated land.

A point in connection with water supplies is the quantity of compensation water that should be given off. It seems absurd that this should be left to be fought out under every little Bill, and it should be fixed definitely by the Legislature. It often happens that the promoters of a scheme, where no landed proprietor has sufficient interest to oppose it, get off with the provision of far too small an amount of compensation water. This matter is really a national one, and should not be settled in the interest of any individual proprietor, but of the public at large. When the available sources of supply are yearly becoming more and more scarce, it is essential that adequate provision should be made to secure that our rivers and streams have at all times a sufficient supply of water sent down them.

In addition to the supply of water for ordinary domestic purposes, several works have been constructed in Scotland for utilizing water power for commercial purposes. The first of these appropriated the water flowing over the Falls of Foyers on the south side of Loch Ness. This was done by the British Aluminium Company; and though from a commercial point of view it has been successful, there is not the least doubt that the construction of the works there has greatly spoilt the beauty of the scenery, much to the regret of the large number of tourists who frequent Loch Ness, and of all those who have the preservation of the beauties of Scotland at heart.

This supply became quite insufficient for the purposes of the British Aluminium Company; and the Highland Water-Power Company promoted a scheme in 1899 to take the water of Loch Ericht and some smaller lochs, situated in Perthshire, right across Argyllshire, and make use of it at a manufacturing station to be placed at the head of Loch Leven. In the scheme submitted to Parliament the proposed works were too light, and the compensation water proposed to be given much too small, while the waters of Loch Ericht were diverted from their natural watershed into an adjoining county. The Bill was opposed, among others, by the County Council of Perth and the Tay Salmon Fisheries Commissioners, and was rejected by Parliament. In the session of 1901 the Loch Leven Water-Power Act was passed. It was really part of the former scheme, but without encroaching on Loch Ericht, and provided for the construction of a large concrete dam at the west end of the Blackwater Lochs, and the laying of pipes from it to turbines at the head of Loch Leven. The estimated cost of this scheme was £575,000.

In addition to the use of water for power, several large companies are now working in Scotland producing electricity for power and lighting purposes; and the City of Glasgow has an extensive system for distributing water at high pressure.

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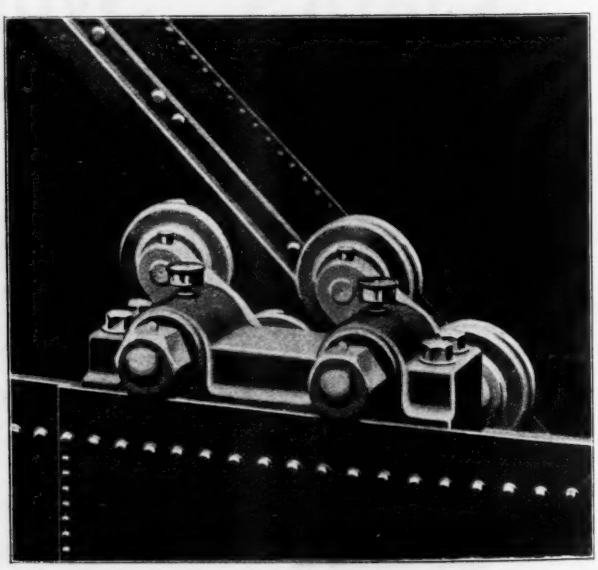

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CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Dec.* 14.

The shipments of pitch last month from the United Kingdom were about 25,000 tons, or (say) half the corresponding month of last year. The quantities for which there is now no market available owing to the war are going into stock; but the home pitch trade is tolerably active. London manufacturers ask 28s. 6d. to 30s. net per ton. Other prices are: Benzol, 90 per cent., 1s. to 1s. 2d. net and naked; 90-160 solvent naphtha, 1s. net and naked; carbolic acid, 3s. 2d. to 3s. 3d. net per gallon, casks free; creosote, 4d. to 4½d. net in bulk; pyridine bases, 8s. 3d. net in buyers' drums. Naphthalene is in large demand, and record prices are obtainable.

Sulphate of ammonia is strong; £11 2s. 6d. net in buyers' bags at makers' works for minimum 25 per cent. having been paid for December, and a premium for the spring.

Tar Products in the Provinces.

Dec. 14.

The markets for tar products keep fairly steady; but the volume of business transacted during the week was not very great. Benzol is steady, and better prices were paid in some quarters; but there still appears to be a fair amount of the article offering. Toluol is slightly weaker, and transactions are reported at lower prices. Solvent naphtha is steady, though there is very little business doing. Creosote remains firm, and the demand is fairly good. Crude carbolic keeps steady, and sales have been made in the neighbourhood of 3s. 1d. per gallon.

The average values during the week were: Value of liquid products in one ton of tar, 16s. 9d. to 18s. 3d. Benzol, 90 per cent., naked, North, 8½d. to 9d.; 50-90 per cent., naked, North, 1s. 2d. to 1s. 3d. Toluol, naked, North, 2s. 3d. to 2s. 4d. Crude naphtha, in bulk, North, 5¾d. to 5¾d. Solvent naphtha, naked, North, 8½d. to 9½d. Heavy naphtha, naked, North, 11d. to 1s. Creosote, in bulk, North, 3⅜d. to 3 7/16d. Heavy oils, in bulk, 4d. to 4½d. Carbolic acid, casks included, 60 per cent., East and West coasts, 3s. to 3s. 1d. Naphthalene, £4 10s. to £10; salts, 60s. to 65s., bags included. Anthracene, "A" quality, 2d. per unit; "B" nominally ¾d.

Sulphate of Ammonia:

LIVERPOOL, *Dec.* 12.

During the past week the market for this article has been very animated, and a large volume of business has been done at rapidly advancing prices. Besides the requirements for covering sales made previously for December delivery, some important new orders have come from direct buyers; and the nearest values at the close are £11 8s. 9d. per ton f.o.b. Hull, £11 11s. 3d. per ton f.o.b. Liverpool, and £11 12s. 6d. per ton f.o.b. Leith. For future delivery, great activity has also been displayed; and a considerable number of transactions have taken place for January-June delivery at up to £11 12s. 6d. per ton f.o.b. at the principal ports.

Nitrate of Soda.

The tone of this market is distinctly firmer, and holders on spot now require 9s. 9d. per cwt. for ordinary and 10s. 3d. for refined quality.

Sulphate of Ammonia.

From another source it is reported that the market for this article has risen considerably during the past week; but there is no doubt that there is a fair amount of speculation going on which has caused the price to rise so. Outside London, makes are quoted at £10 12s. 6d. to £10 15s.; Hull, £11 5s. to £11 7s. 6d.; Leith, £11 7s. 6d.; Liverpool, £11 6s. 3d.; Middlesbrough, £11 5s. to £11 7s. 6d.

A Lancashire Tar Distiller writes, under date of Dec. 9: "Referring to your report on 'Current Sales of Gas Products' in yesterday's 'JOURNAL,' the only price named therein for pitch is 30s. London. In the North here the price to-day is about 20s. per ton, and the former figure is apt to mislead. I shall be glad if you will look into this matter for yourself and remedy the error. The price should be what can be obtained—not what could not be obtained. The figure 30s. might with equal truth be stated 35s. or 40s."

COAL TRADE REPORT.

Northern Coal Trade.

The coal trade is somewhat brisker, and there is a rather fuller shipment of coal, although the high freights still limit foreign inquiries. In the steam coal trade, there have been more orders placed. Best Northumbrians are about 13s. per ton f.o.b. for early delivery; second-class steams are about 10s. 7d. to 11s 3d. per ton; while for steam smalls the price ranges from 7s. 6d. to 8s. 9d. per ton f.o.b., with a fairly good demand for the latter class. Some heavy contracts for steam coals for next year are in the market, and prices are rather lower. In the gas coal trade, the demand is now full for home consumption, and fairly good for French and Italian ports. Best Durham gas coals are firm at 12s. 6d. per ton f.o.b.; second-class gas coals are from 10s. 9d. to 11s. 3d. per ton; and for "Wear Specials," the quotation is about 13s. per ton f.o.b., with a good demand. For a Norwegian town, a contract has been booked for 20,000 tons of good Durham gas coals; and the f.o.b. price is put as from 12s. 4d. to 12s. 6d. per ton. Palermo also seeks to contract for 10,000 tons of best Durham gas coals for prompt delivery; and there is an inquiry for occasional cargoes for the Mediterranean, despite the heavy freights that have to be paid to secure tonnage. Coke is firm generally. Gas coke is plentiful this season. Exports of coke are full from the Tyne, and good gas coke is 10s 9d. to 11s. 9d. per ton f.o.b. in the river.

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Loughborough Gas Profits.

In moving the adoption of the Gas Committee's report, at last week's meeting of the Loughborough Town Council, Mr. W. F. Charles (the Chairman of the Committee) expressed regret that the gas profits were down to the extent of £948, of which £364 was accounted for by the increased price of coal, and £150 by the raising of workmen's wages. The reduction by 2d. per 1000 cubic feet in the price of gas had so far reduced the profits by £364. In his opinion, it had been a great mistake to reduce the price. The necessity existed for creating a substantial reserve in connection with the undertaking. If the works were modernized, as they ought to be, they would obviously be able to produce cheaper gas. Successful results had attended the installation of a mechanical stoker. A ton of coal was now producing 1000 cubic feet more gas than under the old plan. The unwisdom of reducing the price was supported by Mr. Toone, who seconded the adoption of the report. Mr. Clemerson, who had been instrumental in securing the reduction, claimed that several towns were producing gas at a lower price than Loughborough. The report was adopted.

Patriotism at Hastings.—When the report of the gas examiner (showing the illuminating power to be 15 standard candles) came before the Hastings Town Council, Mr. Pelham said the gas was only just up to the standard, and he thought this was unsatisfactory. Dr. Gray, however, put the matter very plainly when he replied that so many men from the gas-works had gone on service that it was difficult to do more; and if they wanted more done, the country must suffer. Mr. Pelham, in spite of this, continued to argue that the gas was a poor illuminant; and at last Dr. Gray retorted that it was extraordinary that a member could be found, even in the Council, to raise a point like that at such a time.

Mossley Corporation Gas Undertaking.—At the last meeting of the Mossley Town Council, Alderman Lees (Chairman of the Gas Committee) referred to a resolution in regard to the laying of new mains in the Saddleworth district. The Committee had decided to lay new mains along certain roads (Lydgate and Sharon), to prepare for the development of these districts; but there was a condition that the Saddleworth authorities were to erect a number of new lamps. There had been a further suggestion to lay a new main at Denshaw. The capital expenditure on these schemes would have been about £1200, and the annual loss to Mossley £50. Still, they were desirous of finding work for their men during the winter, and had decided—with the Saddleworth Council's support—to proceed with the scheme for Lydgate and Sharon. They had, however, found it impossible to entertain the Denshaw proposal, because of the cost and the improbability of a development which would repay them in some measure. He now regretted to see from the local newspapers that the Saddleworth Council had refused to agree to the Lydgate and Sharon schemes unless Denshaw was also dealt with. Their workmen would, in the circumstances, be affected.

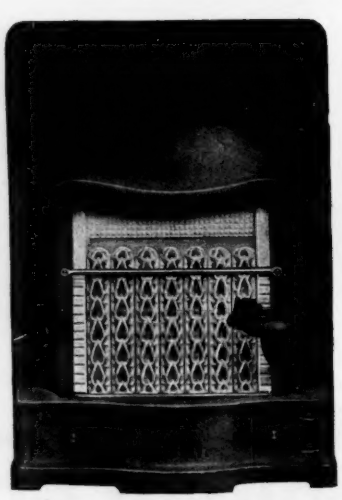
Gas-Mantles in Holland.

The following remarks on this subject appeared under the heading of "Notes from Overseas" in the "Ironmonger" last Saturday: "Some anxiety has been caused among the Dutch gas industry by the suggestion that a scarcity of incandescent gas-mantles might occur in Holland owing to the prohibition of the exportation of thorium nitrate from Germany, and the inordinate demand for Dutch incandescent mantles from England. As a result, the Dutch Association of Coal Gas Manufacturers have held an inquiry among the makers and importers of incandescent mantles in Holland which has shown that for the present there is no reason for demanding the prohibition of the export of mantles from Holland in the interests of consumers within the country. As for the alternative suggestion, that Germany should be asked to remove her embargo on the exportation of thorium nitrate, it is thought that to do so would be to court a refusal. Moreover, the bulk of the raw material in Germany is in the form of monazite sand, from which thorium is extracted; and it is more than possible that before long there will be no saltpetre available for thorium manufacture, as all the saltpetre supplies in Germany will be needed by the Army. It is believed, in fact, that the German embargo on the exportation of thorium nitrate has been inspired quite as much by the wish to curtail the consumption of saltpetre as by the desire to deprive England of incandescent mantles. It is a fact that the export business in mantles from Holland to England has increased enormously since the war began. Much of the Dutch supply comes from Germany, some from Switzerland, and some is manufactured in Holland, though the Dutch output is not sufficient even to supply the home market. Three of the Dutch manufacturers profess to be somewhat troubled by the possibility that their supplies of thorium nitrate may come to an end. In the meantime, users in Holland are invited to pay more attention to the saving of incandescent mantle ash."

Fatality to Soldiers at St. Leonards.—Two soldiers of the Royal Welsh Fusiliers, who were billeted in a house at St. Leonards, were found dead in bed, with the room full of gas, on the morning after their arrival. The room was a small one, without a fireplace; and the gas was full on, and unlit. The burner was in good order; and it is surmised that, being very tired, one of the men blew out the gas without thinking what he was doing, or else that his sleeve caught in the tap, and turned it on again, after he had put the light out.

Gas for School Luncheons.—At the High School at Rockford (Ill.) there is a luncheon equipment consisting of four sections of "Eclipse" ranges, with three 24-inch ovens underneath, an auxiliary pastry oven, and several hot-plates and boiling-stoves. There are 1327 students at the school, and the average number who use the lunch-room daily is 400. During the school year of 1913, there were served 64,208 luncheons, at an average cost of 13c.; the average daily attendance being 355. The quantity of gas used was 159,200 cubic feet, or 2·48 cubic feet per luncheon.

THE "LANCET" REPORT ON PARKINSON GAS FIRES.



"These were all well designed and attractively finished fires, and not one of them showed the slightest escape of combustion products, either when tested in the open, unattached to a chimney, or when unprovided with a flue or elbow.

We regard these fires, therefore, as being satisfactory from the hygienic point of view."

(Extract from the "Lancet," Nov. 14th, 1914).

THE PARKINSON STOVE CO., LTD.,
BIRMINGHAM AND LONDON.

Road Maintenance and Watering in the Holborn District.—According to the annual report of Mr. E. F. Spurrell, the Borough Surveyor of Holborn, the Council pay the Metropolitan Water Board at the rate of 3s. per mile per annum on the total mileage of roads in the borough, in addition to the usual charge of 6d. per 1000 gallons for water used upon them. This arrangement enables the Council to draw water from any of the stand-pipes for paving purposes, and thus avoid the necessity of measuring-up each repair work carried out, and paying for it under the Board's schedule.

Metropolitan Water Board's Deficiency.—At the meeting of the Metropolitan Water Board last Friday, the Finance Committee reported that the deficiency for the past year, which was estimated at more than £104,000, had been certified by the Auditor at £15,385. The Committee attribute this satisfactory position to the fact that the income exceeded the estimates by about £70,000, due to the favourable conditions of the summer of 1913, and to a further reduction in the allowances for empty premises. Savings under the head of pumping and distribution amounted to upwards of £19,000. The deficiency for the current financial year is estimated at £94,700.

Nottingham Water Profits.—Divergence upon the part of the two Elective Auditors for Nottingham in computing the profits of the water undertaking, gave rise to some criticism at the last meeting of the Council; it being pointed out that, whereas one gave the percentage of profit as 5·48, the other placed it at 7·08. The Chairman of the Committee (Mr. A. R. Atkey) explained that the apparent difference was accounted for by the fact that one of the Auditors had taken into account the amount which had to be paid to the Derwent Water Board, while the other had not. The necessity of a joint report by the Auditors, wherein there might be agreement upon points of fact, was insisted upon in the discussion.

Petrol Lighting Question at Balcombe.—The lighting question at Balcombe has assumed an interesting phase. The instalment of a petrol-gas system in the village fostered the anticipation that public lighting would follow; but when the parishoners met to adopt the Lighting and Watching Act it was found that the majority was not of the required numerical strength. A poll was demanded, but withdrawn on the intimation that it would not be taken of the parish, but of those present. It appears that since then somebody has approached the Local Government Board; but this authority, instead of helping the parish out of its difficulty, has left it in a state of uncertainty as to whether it should be polled or only the parishoners at the meeting. The use of the ballot-box at the meeting is supported by legal minds; but the opinion is strongly held that this view is wrong.

Gas Output at Heywood.—In the Heywood Town Council last week, Mr. David Healey (the Chairman of the Gas Committee) drew attention to the decreased consumption of gas for October of 871,000 cubic feet, due principally to short time in the cotton-mills. He further stated that the decrease for November would be over a million cubic feet. Some of their neighbours had been talking of increasing the price of gas; but in Heywood an effort would be made to keep the charge down. There was an increased demand for high-pressure lighting; and the Committee had decided to put down a larger engine.

A lecture was delivered by Mr. Matt. Dunn, of Stockton-on-Tees, last Saturday, before the Middlesbrough and District Association of Foremen Engineers and Chief Draughtsmen. The subject dealt with was the "Power and Value of Coal Gas." The industrial and other uses of gas were fully explained; and both the lecturer and the large audience who attended had quite a good time—so good, indeed, that a continuation lecture has been booked for next April. The apparatus exhibited by Mr. Dunn for demonstration purposes was specially appreciated. It included examples of up-to-date lighting, fires, radiators, cookers, laundry appliances, ventilating appliances, electric goods for comparative purposes, a gas-engine, and industrial apparatus—shown in operation.

We learn from a local paper that Hastings can claim to have been one of the first towns in the kingdom to embark in toy-making. Prior to the outbreak of the war, the Hastings branch of the Christian Social Union had formed a Spare Time Industry Committee, to teach women employed in seasonal trades how to make toys; and this proved the inauguration of what promises to become an important local industry. When the war broke out, the Committee discussed the feasibility of extending their work, but they had not the necessary capital. They therefore applied to the Local Committee for the Prevention and Relief of Distress; and the Industries' Sub-Committee (of which Mr. C. F. Botley, the Engineer and General Manager of the Hastings and St. Leonards Gas Company is the Chairman) came to the conclusion that the proposal was a sound one. A grant was made from the Mayoress's fund; and three members of the Sub-Committee were appointed to serve on the Industries Committee—viz., the Mayor, Mr. Botley, and Mr. W. J. Ransom. Thanks to Mr. Botley and the Directors of his Company, the spacious and well-lighted Board-room over the show-rooms at the Queen's Road premises has been utilized as a workroom, and it is giving employment to twenty women, who are, it is stated, competent to produce toys which come up to trade requirements.

GAS COMPANIES IN THE STOCK EXCHANGE.

There is good reason to hope that during the past week some real advance has been made towards an opening of the Stock Exchange at no distant date. It may be early in the New Year; but, of course, it cannot be expected to amount to a resumption of "business as usual." There is no doubt a genuine desire on the part of the representatives of the various interests involved, and of the Government, to attain so desirable a goal as soon as it may be with full warrant of safety. But this will mean a big "if;" and the present conditions of cash dealings, minimum prices, and general control will probably have to be maintained for some time to come. Patience must be exercised, for a premature advance might be most disastrous. So far as the operations of the week are concerned, business was at first very quiet, and the general tone no better than moderate. But the advent of news of the battle of the Falklands infused much cheerfulness, with brisker business and rising prices. And this tendency had not run itself out by the end of the week. In the Money Market, a large amount was paid into the Bank of England on Monday by allottees of the War Loan who availed themselves of the discount terms offered for immediate payment of all calls in full; but the supply in the market was very abundant. Discount terms, however, hardened considerably, and closed firm.

Bank rate (fixed Aug. 8), 5 per cent.; last year, 5 per cent.

OFFICIAL QUOTATIONS AT THE CLOSE OF THE STOCK EXCHANGE ON JULY 30.

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	April 8	2½	Alliance & Dublin Ord.	59–64	..	3 18 2
374,000	,,	July 10	4	Do. 4 p.c. Deb.	76–79	..	5 1 3
280,000	5	April 29	7½	Bombay, Ltd.	5¼–6¾	..	5 17 8
50,000	10	Feb. 26	16	Bourne-mouth Gas & Water: B 7 p.c.	29–30	..	5 6 8
373,480	10	,,	7	Bourne-mouth Gas & Water: 10 p.c.	15–15¼	..	4 10 4
95,000	10	,,	6	Bourne-mouth Gas & Water: Pref. 6 p.c.	13½–14	..	4 5 9
380,000	Stk.	Feb. 26	14	Brentford Consolidated	261–266	..	5 5 3
330,000	,,	,,	11	Do. New	204–209	..	5 5 3
50,000	,,	,,	5	Do. 5 p.c. Pref.	109–111	..	4 10 1
206,250	,,	June 11	4	Do. 4 p.c. Deb.	91–93	..	4 6 0
217,380	Stk.	Feb. 26	11	Brighton & Hove Orig.	208–213	..	5 3 4
244,200	,,	,,	8	Do. A Ord. Stk.	154–159	..	5 0 8
530,000	20	Mar. 26	12½	British	44–45	..	5 11 1
120,000	Stk.	June 26	4	Do. 4 p.c. Deb. Stk.	88–90	..	4 8 11
245,771	Stk.	June 26	4	Buenos Ayres 4 p.c. Deb.	85–87	..	4 12 0
100,000	10	—	—	Cape Town & Dis., Ltd.	1¼–2½	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4–6	..	—
100,000	Stk.	June 26	4½	Do. 4½ p.c. Deb. Stk.	70–75	..	6 0 0
157,150	Stk.	Feb. 26	5	Chester 5 p.c. Ord.	104–110	..	4 10 11
1,513,280	Stk.	Feb. 12	5/9/4	Commercial 4 p.c. Stk.	106–108	..	5 1 2
560,000	,,	,,	5½	Do. 3½ p.c. do.	103–105	..	5 1 6
475,000	,,	June 11	3	Do. 3 p.c. Deb. Stk.	69½–71½	..	4 8 11
800 000	Stk.	,,	4	Continental Union, Ltd.	76–79	..	5 1 3
200 000	,,	,,	7	Do. 7 p.c. Pref.	115–118	..	5 18 8
492,270	Stk.	—	6	Derby Con. Stk.	123–125	..	4 16 0
55,000	,,	—	4	Do. Deb. Stk.	102–104	..	3 16 11
1,002,180	10	July 29	10	European, Ltd.	17½–18*	..	5 11 1
16,362,910	Stk.	Feb. 12	4/17/4	Gas Light and Coke: 4 p.c. Ord.	98–102	..	4 15 6
2,600,000	,,	,,	3½	Gas Light and Coke: 3½ p.c. max.	76–79	..	4 8 7
4,062,235	,,	,,	4	Gas Light and Coke: 4 p.c. Con. Pref.	96–99	..	4 0 10
4,674,850	,,	June 11	3	Gas Light and Coke: 3 p.c. Con. Deb.	72½–74½	..	4 0 6
258,740	Stk.	Mar. 12	5	Hastings & St. L. 5½ p.c.	87–89	..	5 12 4
70,000	10	April 29	11	Hongkong & China, Ltd.	16½–16¾	..	6 11 4
131,000	Stk.	Mar. 12	⅞†	Ilford A and C	151–154	..	5 2 4
65,780	,,	,,	6¾†	Do. B	115–118	..	5 8 0
65,500	,,	June 26	4	Do. 4 p.c. Deb.	92–94	..	4 5 1
4,940,000	Stk.	May 14	9	Imperial Continental	150–160	..	5 12 6
1,235,000	Stk.	Feb. 12	3½	Do. 3½ p.c. Deb. Red.	84–86	..	4 1 5
200,242	Stk.	Mar. 12	6½	Lea Bridge Ord. 5 p.c.	119–121	..	5 7 6
561,000	Stk.	Feb. 26	10	Liverpool United A	211–213	..	4 13 11
718,100	,,	,,	7	Do. B	146–148	..	4 14 7
306,083	,,	June 26	4	Do. Deb. Stk.	97–99	..	4 0 10
75,000	5	June 11	6	Malta & Mediterranean	4½–4⅝	..	6 9 9
250,000	100	April 1	4½	Met. of Melbourne 4½ p.c. Deb.	99–101	..	4 9 1
541,920	20	May 28	4	Monte Video, Ltd.	11½–12	..	6 13 4
1,775,892	Stk.	July 29	4½	Newo'tle&G'tesh'd Con.	98½–99½	..	4 10 6
529,705	Stk.	June 26	3½	Do. 3½ p.c. Deb.	82–83	..	4 4 10
55,940	10	Feb. 26	7/14/0	North Middlesex 7 p.c.	14–15	..	5 2 8
300,000	Stk.	May 14	8	Oriental, Ltd.	117–122	..	6 11 2
60,000	5	Mar. 26	10	Ottoman, Ltd.	7⅞–7¾	..	6 9 0
60,000	50	Feb. 26	13	Portsea, Island B	128–131	..	4 19 3
100,000	50	,,	12	Do. C	118–121	..	4 19 2
249,980	5	April 29	8	Primitiva Ord.	5¼–6	..	6 18 4
499,960	5	June 26	5	,, 5 p.c. Pref.	4¾–5	..	5 0 0
521,600	100	June 2	4	,, 4 p.c. Deb.	91–93	..	4 6 0
346,198	Stk.	June 26	4	River Plate 4 p.c. Deb.	85–87	..	4 12 0
150,000	10	May 14	6	San Paulo: 6 p.c. Pref.	10½–11	..	5 9 1
125,000	50	July 1	5	San Paulo: 5 p.c. Deb.	47–49	..	5 3 0
135,000	Stk.	Mar. 12	10	Sheffield A	223–224	..	4 9 3
209,984	,,	,,	10	Do. B	222–224	..	4 9 3
523,500	,,	,,	10	Do. C	220–222	..	4 10 1
90,000	10	May 28	9	South African	10½–11½	..	7 16 6
6,429,895	Stk.	Feb. 12	5/9/4	South Met., 4 p.c. Ord.	111–113	..	4 16 8
1,895,445	,,	July 10	3	Do. 3 p.c. Deb.	72½–74½	..	4 0 6
209,820	Stk.	Feb. 26	8½	South Shields Con. Stk.	157–159	..	5 6 11
952,795	Stk.	Feb. 26	6	S'th Suburb'n Ord. 5 p.c.	114–116	..	5 3 5
60,000	,,	,,	5	Do. 5 p.c. Pref.	110–112	..	4 9 3
137,058	,,	June 26	5	Do. 5 p.c. Deb. Stk.	116–118	..	4 4 9
629,740	Stk.	May 14	5	Southampton Ord.	99–102	..	4 18 0
120,000	Stk.	Feb. 12	7½†	Tottenham District: A 5 p.c.	135–138	..	5 8 8
742,275	,,	,,	6†	Tottenham District: B 3½ p.c.	115–117	..	5 2 7
181,255	,,	June 26	4	Tottenham District: 4 p.c. Deb.	87–89	..	4 9 11
182,380	10	Dec. 30	5	Tuscan, Ltd.	5–6	..	8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	93–95	..	5 5 3
236,476	Stk.	Mar. 12	5	Tynemouth, 5 p.c. max.	108½–109½	..	4 11 4
30,000	Stk.	Feb. 26	8⅜	Wandsworth, Wimbledon, and Epsom—Wandsworth A 5 p.c.	151–156	..	5 7 4
255,636	,,	,,	6¾	,, B 3½ p.c.	129–134	..	5 2 7
108,075	,,	,,	5/17/3	,, C 3½ p.c.	110–115	..	5 2 0
352,000	,,	,,	6¾	Wimbledon 5 p.c.	117–122	..	5 0 5
98,000	,,	,,	6¾	Epsom 5 p.c.	121–126	..	5 5 2
88,416	,,	June 26	3	3 p.c. Deb. Stk.	66–69	..	4 6 11

Prices marked * are "Ex Div." † Next Dividend will be at this rate.

Last Thursday, Messrs. Nightingale, Phillips, and Page, offered for sale, in accordance with an announcement which appeared in our advertisement columns, £10,000 of consolidated ordinary stock of the Kingston Gas Company. It was put up in lots of £100 and £50 each, and it realized from £112 10s. to £114 10s. per £100. This is a 5 per cent. stock; but the last dividend was at the rate of £5 12s. 6d. per cent. The last auction sale of gas and water stocks conducted by Messrs. A. & W. Richards resulted in £14,640 of consolidated ordinary stock in the Lea Bridge District Gas Company being sold at prices varying from £118 to £118 10s., and 330 new ordinary £10 shares in the South-end Water Company at £9 to £9 2s. 6d. each.

Dwellers in the suburbs of the Metropolis had an unpleasant experience last Friday evening, when, owing to an accident at the electricity generating station at Greenwich, practically the whole of the London tramway service was suspended for many hours. The precise nature of the accident is attributed, in an official statement issued by the tramway authorities, to an explosion which occurred on the switch-board gallery at the station shortly after five o'clock. The cables connecting the generators with the switchboard were set on fire, and serious damage was done. The only tramcars not affected were those running from Greenwich through Deptford and Lewisham, which take their supply of current from the Deptford station, which is independent of that at Greenwich.

Tenders were recently invited, in the advertisement columns of the "JOURNAL," for £5000 of ordinary stock in the Reading Gas Company (at a minimum price of £102 per £100 of stock). The success of the issue has been such that the Company—especially considering existing financial conditions—have much reason to congratulate themselves. The amount of the tenders received for the stock was from two to three times greater than the total offered; and the average price realized was considerably in excess of the minimum fixed.

APPLICATIONS FOR LETTERS PATENT.

23,443.—JAUBERT, G. F., "Production of incandescent light from rare earths" Dec. 2.
23,460.—CLIMIE, W., JUN., "Purifying gas." Dec. 3.
23,542.—NÜBLING, R., "Retort mouthpieces." Dec. 4.
23,552.—SOUTH METROPOLITAN GAS COMPANY and CHANDLER, D., "Gas-ovens." Dec. 4.
23,564.—SIMMANCE, J. F., "Measuring or regulating temperature." Dec. 4.
23,592.—RICHMOND GAS STOVE AND METER COMPANY, LIMITED, and HARTLEY, H., "Burners." Dec. 5.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

GAS MANAGER. Wantage Urban District Council. Applications by Dec. 28.
DRAUGHTSMAN. No. 5964.
CARBONIZING FOREMAN. Gravesend Gas Company.
RETORT-HOUSE FOREMAN. No. 5969.
MANTLE MANUFACTURER. "Mantles," c/o William Porteous and Co.
OUTDOOR INSPECTOR (Assistant). No. 5967.
WATER INSPECTOR. No. 5963.

Agency Wanted (London). No 5966.

Pupils.

No. 5965.
No. 5962.

Plant, &c. (Second Hand), Wanted.

PLUNGER PUMP. "Artesian," c/o Deacon's, Leadenhall Street, E.C.

Plant, &c. (Second-Hand), for Sale.

CONDENSERS, WASHERS, AND SCRUBBERS. Croydon Gas Company.
WATER-METER. No. 5908.

Gas-Works Wanted.

Particulars to "PRINCIPAL," Scripps's Advertising Offices, 13, South Molton Street.

Sales of Stocks and Shares.

SHREWSBURY GAS LIGHT COMPANY (Mortgage Bonds).

TENDERS FOR

Carbonizing Plant.

MANCHESTER GAS DEPARTMENT. Tenders by Jan 7.

Coke.

SLOUGH GAS COMPANY. Tenders by Dec. 22.

Gasholder and Steel Tank.

CUDWORTH URBAN DISTRICT COUNCIL. Tenders by Jan. 3.

Tar and Liquor.

BRECON GAS COMPANY. Tenders by Jan. 5.
GAINSBOROUGH GAS DEPARTMENT. Tenders by Dec 19.
HARWICH GAS COMPANY. Tenders by Jan. 4.
SLOUGH GAS COMPANY. Tenders by Jan. 11.
WORKSOP GAS COMPANY. Tenders by Dec. 18.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

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Payable in advance. If credit is taken, the charge is 25s. a year.

Abroad (in the Postal Union): £1 7s. 6d., payable in advance.

All Communications, Remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

Telegrams: "GASKING, FLEET LONDON." Telephone: Holborn 6857.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 171, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

TAR WANTED.
THOMAS HORROCKS & SONS, LTD..
Albert Chemical Works,
NORTON STREET, MILES PLATTING, MANCHESTER.
Pitch, Creosote, Brick and Fuel Oils, Benzol, Solvent Naphtha, Carbolic, Lysol, Sulphate of Ammonia.

ENQUIRIES SOLICITED.

FOR Gas-Works Plant of Every Description; also SULPHATE OF AMMONIA and SULPHUR RECOVERY PLANTS.
C. & W. WALKER, LIMITED,
DONNINGTON, NEWPORT, SALOP.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, London, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION.
Telephones: 815 Oldham, and 2412 Hop, London.
Telegrams—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

HUTCHINSON BROTHERS, Ltd.,
FALCON WORKS, BARNSLEY.
MANUFACTURERS OF
GAS METERS (Ordinary and Prepayment),
"FALCON" INVERTED LAMPS and SQUARE LANTERNS for Street Lighting,
INVERTED BURNERS and CONVERSION SETS for Street Lamps.

TAR AND GAS LIQUOR WANTED
IN LONDON DISTRICT.

THOMAS CLAYTON (Oldbury) Ltd.,
BRENTFORD, W.
Telegrams: Canal Brentford. 'Phone: Ealing 17.

SPENCER'S PATENT HURDLE GRIDS.

THE very best Patent Grids for Holding Oxide Lightly.
See Illustrated Advertisement, p. 634.

OXIDE OF IRON.
We are in a position to Supply Oxide of Iron promptly, and invite Enquiries.
SPENT OXIDE WANTED.
BALE & CHURCH, LTD.
5, CROOKED LANE, LONDON, E.C.

"TORTO" FIRE CEMENT.
BALE & CHURCH, LTD.
5, CROOKED LANE, LONDON, E.C.

"KLEENOFF," THE COOKER CLEANSER
Tins for sale to Consumers.
In Bulk for Works Use.
BALE & CHURCH, LTD.
5, CROOKED LANE, LONDON, E.C.

D. ANDERSON AND COMPANY,
GAS LIGHTING ENGINEERS AND CONTRACTORS.
18 & 20, FARRINGDON ROAD, LONDON, E.C.
Telegrams: "DACOLIGHT LONDON." Telephone: 2886 HOLBORN.

GAS PLANT for Sale—We can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
FIRTH BLAKELEY, SONS, AND COMPANY, LIMITED Church Fenton, near LEEDS.